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WASTE RESOURCE MANAGEMENT

AESC UK

AESC PLANT 3 DEVELOPMENT

Environmental Statement

Appendix 3.3 Glint Assessment

February 2024

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AESC UK

AESC PLANT 3 DEVELOPMENT

Environmental Statement

Glint Assessment

February 2024

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EXECUTIVE SUMMARY

This report seeks to demonstrate the possible effects that reflected sunlight from a proposed rooftop solar development would have on receptors in the vicinity. The receptors include residential properties, road, rail, air traffic and national trails, and the methodology employs the use of:

- A Zone of Theoretical Visibility (ZTV) to identify whether local topography screens those receptors;
- A computer model to determine the times, dates and duration that glint may theoretically be visible; and
- A discussion of existing and proposed screening, such that a realistic assessment of potential effects can be made.

The reflectivity of solar panels is considerably less than many other common materials seen in the built or natural environment. Water bodies, such as reservoirs, lakes and (on a calm day) the ocean have very similar reflective properties to solar panels and represent much larger areas than that taken up by the solar panels at the site. In any case, the overall potential for glint at receptors within the vicinity of the site is low. Fixed panels were assessed for glint effects. The assessment found that, allowing for localised weather conditions, glint is predicted to occur for less than 2.5% of daylight hours at all of the receptors and considerably less than this in most cases.

Of the Observation Points (OPs) assessed in ForgeSolar, seven (7) out of the eleven (11) OPs are expected to receive glint. Most of the OPs are too distant to have direct visibility of the panels, given the topography of the land, the level of intervening vegetation and other screening. However, the OPs that are in the direct vicinity of the site are expected to have an uninterrupted line of sight to the arrays. All of these OPs that have been identified to receive a theoretical view of the proposed development are either predicted low-intensity (green) glint or not at all.

The routes are expected to have a greater level of exposure to glint since there are multiple locations along the route that will have a line of sight to the proposed development. However, in most cases the drivers will be focussed on the stretch of road ahead, meaning the proposed development would either be in the periphery or out of the line of sight. This means that there is a low risk of distraction to road users. In all cases, any glint would be no worse than seeing sunlight reflecting off a window or still water, as solar panels have lower reflective properties than these materials and drivers are experienced at driving in conditions when the sun is low in the sky and far more intense than any glint effect.

1 INTRODUCTION

1.1.1 This assessment considers the potential glint and glare effects associated with the installation of roof-mounted solar photovoltaic arrays, which are proposed as part of an application for a multi-building development in Sunderland.

1.1.2 The application seeks permission to develop 42.39 hectares (ha) of land located within the south-western part of the IAMP site for a battery manufacturing facility, the assembly and warehouse building for storage and distribution, office building, ancillary MEP plant rooms, gatehouse, substation and carparking provision, with associated drainage and landscaping.

1.1.3 The assessment considers the potential effects on ground-based receptors (i.e. road, rail, footpaths and properties) and aircraft operations in the surrounding area. Figure 1.1 shows the site boundary in red and the surrounding land, but the PV arrays will only cover some of structures proposed within this area.

Figure 1.1: Aerial Photography of the Panel Area and Surrounding Land

(© Google 2024; Image © Landsat Copernicus Maxar 2024)

1.1.4 The panels will be mounted flush to the roofs on buildings which they are to be attached. As can be seen in Figure 1.2, below, the roofs of the main buildings included in the application (AESC Plant 3 and the Assembly and Warehousing Building) are curved and so the panels will be set at various angles to the horizontal as they follow the contours of the roof. The panels maximum height above ground level will be 30m.

1.1.5 The national grid reference for the site is 433514, 558883 (easting, northing).

Figure 1.2: Illustrative view of Proposed Development and Surrounding Land

(Reproduced from drawing created by RPS)

1.1.6 For the purposes of the assessment, the arrays have been modelled as illustrated in Figure 1.3 and Figure 1.4. AESC Plant 3 comprises four curved roof sections at differing heights. These are nominally termed PV A-D as shown in Figure 1.3. Each curved roof section has half its panels facing broadly east and the other half facing broadly west. Panel angles are on a continuum, but it is not possible to model each panel individually so the arced rise towards each apex has been sub-divided into two discrete sections and modelled with a fixed indicative panel angle. These sections are termed high (H) and low (L), and then glint reflections have been modelled in accord with the array within which they are located. The Assembly and Warehouse Building follows a similar pattern, with the overall array designated 'PW', with east and west facing, high and low arrays (Figure 1.4).

Figure 1.3: Arrays Assessed covering AECS Building 3

Figure 1.4: Arrays Assessed covering the Assembly & Warehouse Building

2 ASSESSMENT APPROACH

2.1 Defining Glint

2.1.1 Glint, glare and dazzle are often used interchangeably, but are defined in this report as per Table 2.1, below.

Table 2.1: Definitions of Glint, Glare and Dazzle	
Name	**Description**
Glint	Also known as a specular reflection is produced as a direct reflection of the sun on the surface of the solar panel. It occurs with the reflection of light from smooth surfaces such as glass, steel, and calm water.
Glare	A scattered reflection of light. Glare is significantly less intense than glint and is produced from rougher surfaces such as concrete, tarmac, and vegetation.
Dazzle	An effect caused by intense glint and glare, which can cause distraction, and if strong enough reduce the ability of the receptor (pilot or otherwise) to distinguish details and objects.

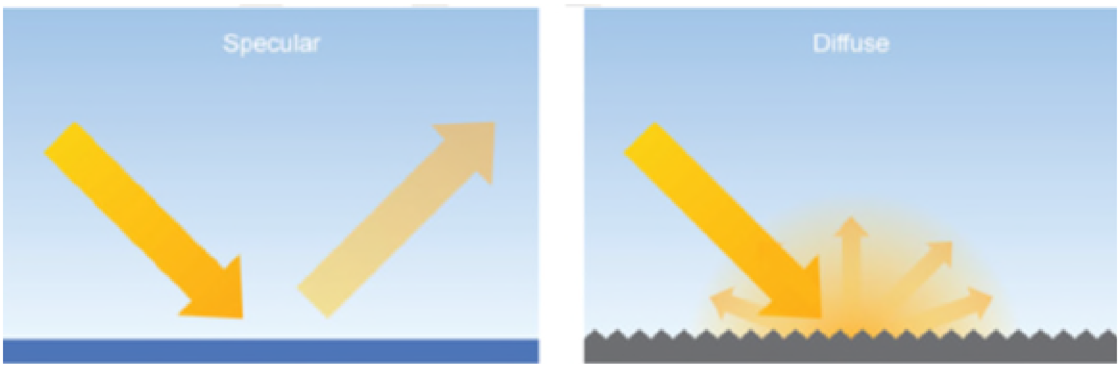

Figure 2.1: Types of Reflection, Specular or Glint (left), Diffused or Glare (right)

(Federal Aviation Administration, 2010)

2.1.2 It is noted that different organisations and agencies apply slightly different definitions to these terms, and some refer to the terms glint and glare interchangeably. Owing to the intensity of glint being much higher than glare, this report will focus on glint alone. The perceived intensity of glint will vary depending on the ambient light level, direction and distance to the receptor.

2.2 Guidelines

2.2.1 There has been no formal technical guidance issued by national government relating to glint and glare arising from utility scale solar PV developments. This is not unusual and until such guidance is provided, this report will consider the guidance provided elsewhere (see Appendix 3.1.1).

2.3 When Can Glint Occur?

2.3.1 Glint can only occur when direct sunlight can reach the solar panels. Diffused lighting caused by weather conditions such as cloud, fog and mist cannot cause glint due to the low energy intensity of the light incident on the panels.

2.3.2 Figure 2.2 shows the total number of daylight hours available each month (red) based on the regional variation for the site. Also shown is the average number of hours of sunshine each month (blue), taken from The Meteorological Office data recorded at Durham (the closest active weather station to the site for which the historic sunshine data is available). Durham is approximately 18km from the site and is expected to be broadly representative of the weather conditions that the site will experience.

2.3.3 Figure 2.2 also shows the ratio of sunshine to daylight displayed as a percentage (green) for each month at the site. As can be seen, the sunniest month on average was July with 177 hours of sunshine. Even then, conditions suitable for glint events to occur are only expected to be present approximately 34% of the theoretical maximum. This is because the ratio of sunshine to daylight is approximately 34% at this time. During less sunny months, glint events may occur for as little as 19% of the theoretical maximum because the ratio of sunshine to daylight is much less at these times.

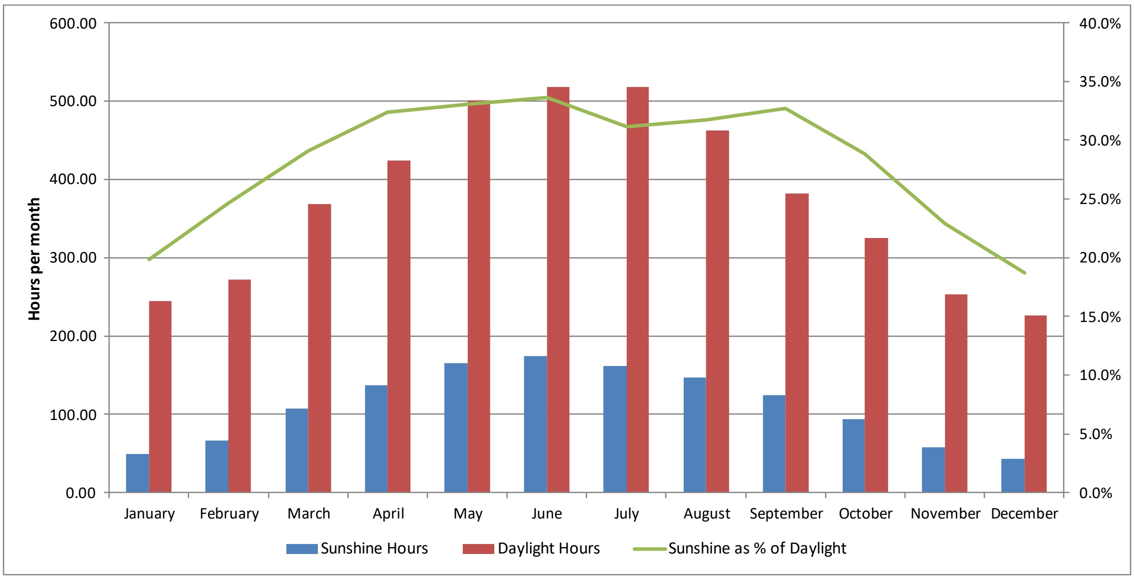

Figure 2.2: Number of Daylight and Sunshine Hours per Month at Durham

2.4 Reflectivity

2.4.1 Solar PV panels are designed to absorb sunlight and convert it into electricity. Solar PV panels are not designed to reflect light, although there may still be a small unavoidable reflective component present from modern solar panels.

2.4.2 The glass that forms the surface layer of solar panels is specifically designed with a low iron content to aid the absorption of daylight and thus has a much lower level of reflectivity than the glass typically seen in conventional windows. This means that, with a 75° (degree) angle of incidence, less than 9% of the total incident visible light is reflected, while normal glass reflects approximately 19% of light. Thus, reflectance levels from a given solar site will be much lower than the reflectance generated by standard glass and other common reflective surfaces in the surrounding environment, although reflectance characteristics will also vary with the incidence angle, which changes as the sun moves across the sky.

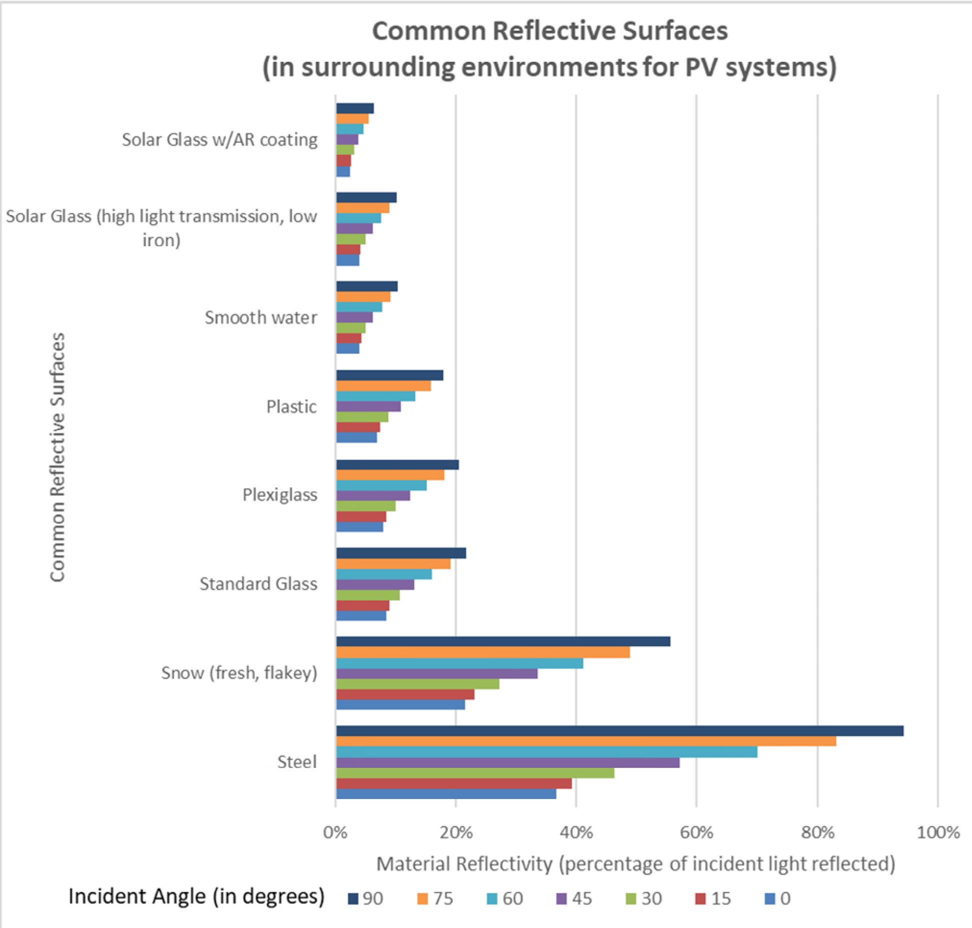

Figure 2.3: Approximate Reflectivity of Common Materials

(Based on data from Sunpower Corporation, 2009)

2.4.3 Solar panels have a comparable reflectivity to that of calm water and considerably lower than that of snow. Any glint that may occur would be less intense than that seen when flying over a reservoir on a calm day or a snow-covered landscape on a bright day.

2.4.4 As can be seen from Figure 2.3, the reflectivity of light incident on solar glass is considerably less than light reflections from many other materials found in the built and natural environment, and it is approximately half that of standard glass.

2.4.5 Some commentators have suggested that solar panels may not be the only source of reflection from solar arrays. Although the steel mounts used to support the panels could reflect sunlight, following construction, the frames are usually well shaded by the solar panels above them and any exposed elements on the end of rows cover an extremely small area.

2.4.6 As distance from the glint source increases, the intensity of the event drops appreciably. This is due to a combination of factors including the diffraction of light after it reflects off the panel, atmospheric conditions such as the presence of particulates, haze, or low cloud, and the diminishing subtended viewing angle.

3 METHODOLOGY

3.1 Introduction

3.1.1 Geometric analysis is used to determine where and when glint events may occur. This examines receptors present at ground level, such as dwellings, roads, national waymarked trails, and railway lines. Receptors are identified using available mapping, aerial photography, and street level imagery. The mathematical calculations used, including limitations, are provided in Appendix 3.1.4.

3.1.2 The glint analysis is completed in several stages using various methods, software models and tools to progressively assess the potential for glint effects, while building an understanding of the local environmental conditions (either existing or proposed) that impact the potential for glint in the local area. The stages and tools used in the assessment are discussed, below.

3.2 Zone of Theoretical Visibility

3.2.1 The first stage in the glint assessment is to identify those receptors that have the potential to receive glint. The ZTV is a computer model that determines whether any part of the site is visible from land surrounding the site based upon local topography and screening from land obstacles (e.g. trees, hedgerows or buildings). It is calculated as described below and is an effective tool used to reduce the study area and eliminate multiple receptors that have no risk of experiencing glint.

3.2.2 A selection of sample points is identified on the site boundary and on land contained within the site. Sample points are chosen as it is unfeasible to perform this calculation on every panel on the site. Terrain data in the form of a Digital Surface Model (DSM) forms the basis for determining whether the site could be visible at local receptors. The DSM comprises a grid of cells where each cell has a given height value and the GIS allows this data to be displayed graphically.

3.2.3 Terrain data comes in various resolutions determined by the cell size, which dictates the overall accuracy and quality of the terrain data. The analysis uses Environment Agency LiDAR data which has a 2m resolution. The data used is considered to be sufficiently accurate for the purposes of modelling a ZTV.

3.2.4 The model predicts whether any of the sample points are visible out to 5km using a line-of-sight calculation between each cell and each sample point. In this case, and an observer height of 1.8m representing the eyeline of a tall person standing up. The output is called a 'viewshed'. For clarity, the output viewshed is converted to show binary results. Irrespective of whether a cell has visibility of one sample point or 100, they are both given a positive result, as opposed to no visibility which is ascribed a negative result.

3.2.5 The DSM also accounts for the heights of surface objects, such as trees and buildings, enabling the ZTV to automatically account for screening. This gives an accurate estimate of the true visibility of the development from the surrounding areas.

3.2.6 The LiDAR data used as the basis of this study is gathered during the winter months where there is little leaf coverage. This will produce a worst-case scenario estimate for the visibility of the panels to receptors.

3.3 Geometric Analysis

3.3.1 The detailed geometric analysis uses a software model to make a prediction on the dates, times and durations of glint effects at fixed positions over the course of a year. The software calculations are complex and completed in several stages, details are provided in Appendix 3.1.4. The software used is the GlareGuage tool originally developed in the United States by the Sandia National Laboratory and since improved upon under licence to ForgeSolar. The times reported as to when glint may occur are reported in Coordinated Universal Time (UTC) and, therefore, daylight savings should be considered when observing the results.

3.3.2 The computer model predicts whether glint effects are possible at a 1-minute temporal resolution over the course of a full year. The model accounts for the maximum panel height, the area taken up by the panels and an observer height.

3.3.3 The GlareGuage model calculates results based on the geometric relationship between the observation point at a fixed height, the reflective plane at a fixed height (panels) and the position of the sun in the sky at each time interval. It, therefore, takes no account of any surface screening features whatsoever. It does not account for the presence of buildings, trees or intervening topography. The software also assumes it is sunny, at the maximum intensity possible given the season, 365 days per year. This means that the computer model suggests when glint can happen, not when it will happen, which is why further interpretation by the assessor is essential.

3.3.4 Route receptors are modelled along a fixed pathway that is defined in the model based on aerial imagery. It is also important to interpret the results correctly for highways as the model will again not account for any of the surface screening features.

3.3.5 After the results have been processed, key information reported by the model (with its inherent limitations) is presented in Table 5.1. It is essential to interpret these results in the context of the wider assessment and the methods and limitations discussed. These results are further refined to account for local prevailing weather conditions, such as cloud cover (see Table 5.2).

3.3.6 Although predictions made by the computer model as to when glint can occur do not account for screening features directly, other tools used in the assessment take this into consideration, such as the ZTV and aerial photography, mapping and observations made by the design team.

3.4 Analysis of Effects

3.4.1 Alongside the ZTV, inspection of available aerial photography and ground level imagery is used to identify the orientation of a receptor and the presence of any intervening obstacles not contained in the DSM, which may screen a receptor from potential glint effects. Such screening features as intervening topography, hedgerows, trees, buildings, proposed planting and other obstacles can have a substantial effect on the glint levels that are predicted when compared with the raw results provided by computer simulation. This is used to provide a more realistic assessment of the anticipated effects. Each receptor is examined in detail to determine how much glint, if any, is expected after accounting for local environmental conditions.

3.4.2 In the software model, glint is characterised by its intensity. Medium intensity glint (described as ‘yellow’ glint) has some potential to generate a temporary after-image, which is where an artificial remnant is momentarily apparent in the vision of the observer after looking towards and then glancing away from a bright object. Low intensity glint (described as ‘green’ glint) has low potential to form a temporary after-image.

3.4.3 High intensity ‘red’ glint is possible, but only where sunlight is concentrated onto a surface, such as in a parabolic collector.

3.5 Cumulative Effects

3.5.1 The assessment considers the potential for cumulative glint effects caused by both the proposed development and existing sites. Cumulative effects using the methods described above are applied to other solar PV sites to determine the overall effect expected at receptors surrounding the site. The full cumulative assessment is provided in Section 5.7 of this report.

3.6 Software, Data and Methods

3.6.1 The assessment methodology has been developed over more than a decade, having been used to complete hundreds of glint assessments across the UK and elsewhere. Improvements and adjustments to the methodology are applied as and when better data, updated methods, software, and guidance become available, in addition to incorporating changes in best practise techniques, consultee engagement and regulatory or policy updates.

3.6.2 Regular improvements are made to the algorithm and implementation of the ForgeSolar model used in the geometric analysis. Recent changes have included adding some capability to model specific visual obstructions (e.g. woodland blocks) and improvements to how reflected light is modelled in the software. The latter of these changes now account for scattering of reflected sunlight, which spreads from the glint source (PV modules) as opposed to behaving like a laser beam. Once the scattering is incorporated into the calculations, different parts of the site can produce glint at the same receptor at the same time, in addition to increasing the theoretical time when glint is reported to occur. The calculations also make use of a random number generator in the results to significantly reduce the time taken for the calculations to be completed. This can cause small variations in the results between runs of the software but is an important improvement to ensure more practicable results can be calculated.

3.6.3 It should be noted that aviation regulators in the United States (where the model is produced and maintained) recognise the ongoing improvements to the model. Details of the mathematical calculations and limitations are provided in Appendix 3.1.4, of this report.

4 BASELINE CONDITIONS

4.1 Current Baseline

Site Description and Context

4.1.1 The site comprises of a mixture of agricultural land located directly to the west and to the north of the AESC Plant 2 development. The overall area within the application redline boundary of the site is 42.39 hectares (ha) in size.

4.1.2 Surrounding the site, the land to the north and west consists of agricultural land, which continues round the boundary of the IAMP area to the east. To the south of the site, the boundary follows the A1290, with the Nissan complex of buildings to the southeast.

4.1.3 The land is largely level, with only minor variations in elevation. The wider area comprises very gently undulating topography dropping gradually to the River Don (690m-700m to the north). Further to the south, south of the River Wear, the land rises to a high point of 136m at the Penshaw Monument.

4.1.4 There is an existing access arrangement to the A1290 from the former West Moor Farm property; this is some 300m to the east of the junction into the Nissan site from the A1290. The site also incorporates an access track linking northwards to North Moor Farm (due to be demolished).

Baseline Survey Information

4.1.5 There are numerous roads and small country lanes within the 5km study area of the site. Not all of these roads will need to be assessed as many of them lie outside of the area within which effects could theoretically be received. Studies have, therefore, focused on receptors lying within the ZTV. Where receptors such as roads cross areas within the ZTV, only those sections within the area predicted to have capacity to receive glint have been assessed. There are five route receptors that have been considered in the assessment that form part of the existing baseline. These include the following:

- Route 1 – A1290;
- Route 2 – International Drive;
- Route 3 – Follingsby Lane:
- Route 4 – A19; and
- *Route 5 - Railway.*

4.1.6 There are also a number of dwellings and commercial premises within the study area and within the ZTV. In some cases, the identified receptor is considered to be representative of several discrete receptors in close proximity. For the purposes of this report, these receptors (Observation Points (OP)) include the following:

- OP1 – Unipres (UK) Limited ;
- OP2 - SNOP building;
- OP3 – Westernmost part of the Nissan business park;
- OP4 - Faltec building;
- OP5 – Amazon facility;
- OP6 - North View Academy;
- OP7 – Northeast Ambulance Service Depot;
- OP8 - Cluster of residential properties 5 km south of the development;
- OP9 – Different Amazon facility to OP5 located on Follingsbury Ln;
- OP10 – Cluster of residential buildings in Fellgate; and
- OP11 - Cluster of properties located just off the A184 at West Boldon.
- OP12 – Strother House Farm
- OP13 – Mypetstop
- OP14 – Hylton Bridge Farm
- OP15 - Hylton Grove Farm

4.1.7 There are also a number of Public Rights of Ways (PRoWs) Surrounding the site; four were identified and include the following:

- One to the southwest of the Site, to the west of the carpark and adjacent to the Elm Tree Farm Garden Nursery and Tearoom;
- A path to the northwest of the Site, to the south of the Amazon facility and to the north of Washington;
- There is a path that runs across the A19 and continues west. This is to the north of the site;
- A PROW also runs out of West Boldon towards the A119 and Town End Farm, this crosses around the southern and eastern sides of the A19 / A1290 Downhill Lane junction; and
- A section of Downhill Lane which runs from Hylton Bridge Farm southwards, over International Drive, along the north eastern boundary of Faltec and to the A1290.

4.1.8 There are a range of other common materials and surfaces likely to cause glint that are already present in the study area. These include, inter alia:

- Glass in windows;
- Conservatories or greenhouses;
- Polythene used in agricultural practices;
- Exposed metal surfaces;
- Flashes caused by light reflecting off passing vehicles; and
- Waterbodies.

4.1.9 There are currently several operational solar developments in the immediate vicinity of the proposed development, which are:

- Nissan Motor Manufacturing (UK) Ltd – Ground mounted PV Array;
- Vantec, Turbine Way - Roof Installation;
- Kasai UK Ltd, Factory 1, Stephenson Road, Stephenson, Washington - Roof Installation; and
- Griffiths Textiles Machines, Alston Road, North Washington – Roof Installation.

4.1.10 In the wider area (beyond 5km), there are a number of other solar PV developments that form existing sources of potential glint, but the distance between these and the site is such that the intensity of any effect would be low and there is very little likelihood of any intervisibility.

4.1.11 It is not possible to accurately quantify the full level of glint currently experienced by receptors in the vicinity of the site as there are a huge variety of sources, a wide spread of receptors and some potential for reflections to arise from mobile sources (e.g. moving vehicles). For the purposes of this assessment, it is presumed that no baseline glint currently occurs at these receptors.

4.2 Future Baseline

4.2.1 The likely evolution of the current baseline without the implementation of the proposed development would be the continuation of agricultural practices. Overall, the future baseline will broadly reflect that of the current baseline.

5 KEY EFFECTS

5.1 Glint Receptors and Effects

5.1.1 Figure 5.1 shows the approximate geographical extent of potential ground glint events. For a glint event to occur on the ground, the receptor must be in the ZTV.

5.1.2 The ZTV identifies locations from where there could be visibility to any parts of the solar arrays. The ZTV uses a bare earth model and does not account for screening from vegetation, buildings or other surface features (excluding topography). Not all locations that have visibility to panels will experience glint. As such, while a point may lie in the ZTV, further inspection of the aerial photography and ground-level imagery could reveal that it cannot receive glint, either because of the geometric alignment or because of screening. This will be discussed, below, for each individual receptor (where relevant).

5.1.3 When the sun is not shining directly on to panels due to cloud or mist (approximately $^2/_3$ of daylight hours during the year), it will not be possible for glint to occur.

5.1.4 Figure 5.1 shows a plan view of the study area including site boundary (outlined in red) and the ZTV (shaded pink). A more detailed drawing is included in Appendix 3.1.2 of this report.

5.1.5 Potential receptors have been visually inspected from aerial photography and those with structures and obstacles between them and the site have not been considered further.

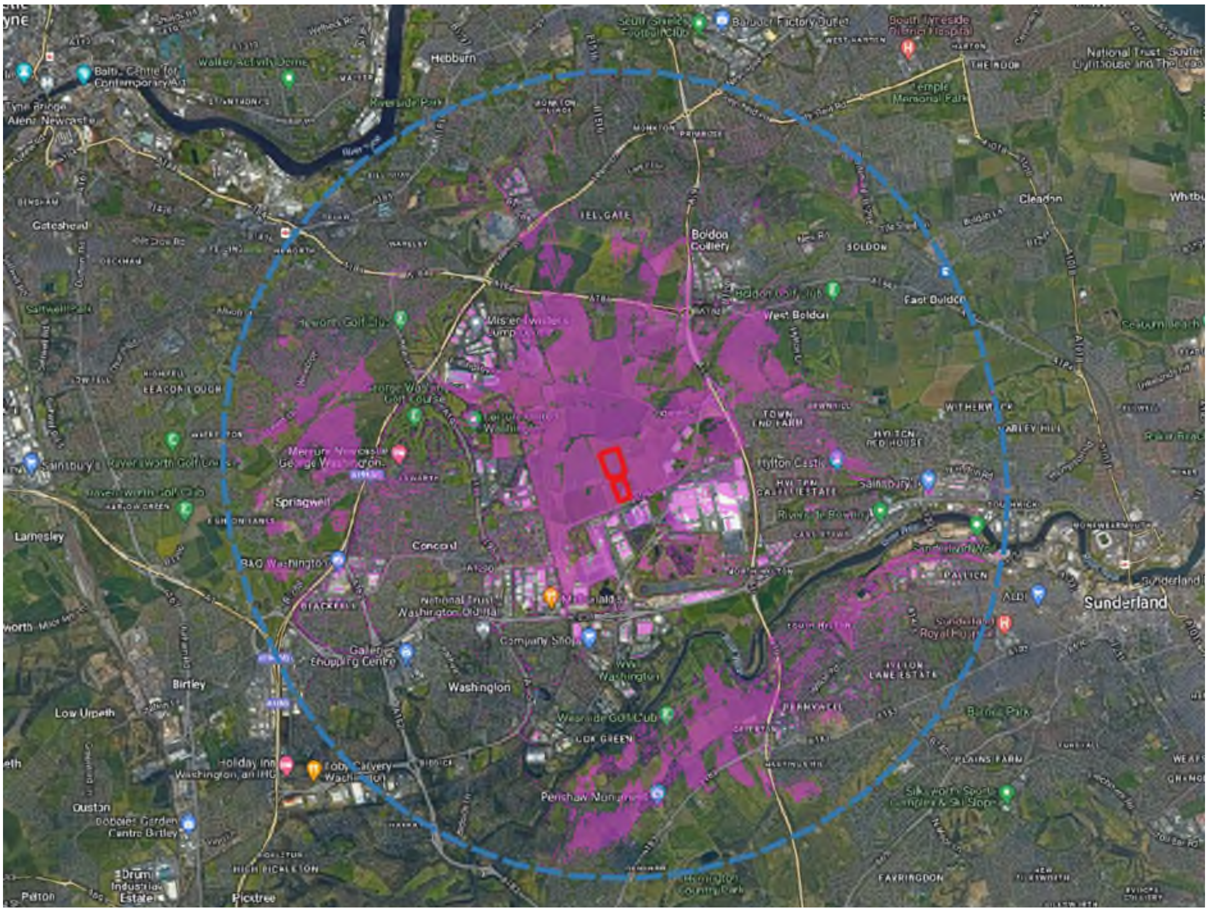

Figure 5.1: Site Boundary (red) and ZTV (pink)

(Google © 2024, Imagery © 2024 Bluesky, CNES/Airbus, Getmapping plc,
Infoterra Ltd & Bluesky, Landsat/Copernicus, Maxar Technologies, The GeoInformation Group))

5.2 Effect on Local Properties

5.2.1 There are many buildings within the vicinity of the proposed development.

5.2.2 For the purposes of this assessment, where a cluster of properties is present in a small area, a representative observation point has been selected to provide information on the likely effects that may be observed. In such an instance, the times, dates, duration, and intensity of glint and screening may vary slightly from property to property, but the effects described are expected to be broadly representative of any property in that cluster. Modelling is based on the theoretical observation of a typical person standing at ground level (1.8m) and using panel heights resembling the height of the development.

5.2.3 The results of the computer modelling are shown in Table 5.1. It should be noted that these results show when glint can occur based on the sun's path and relative locations to the panels and receptors, but do not account for any screening present. The presence of such surface features as trees, hedgerows, buildings, intervening topography and other obstacles will reduce the dates, times and durations of when glint is predicted to occur.

5.2.4 In addition, the results shown in Table 5.1 assume it is bright and sunny, at the maximum intensity possible given the season and do not account for local weather conditions, such as cloud cover. Local prevailing weather conditions will reduce the extents of the predicted effects, particularly annual durations and is accounted for in Table 5.2. Although the earliest and latest times and dates of when glint could occur is reported in Table 5.1, glint would not necessarily occur continuously between these periods. These represent the limits of when glint effects are predicted.

5.2.5 The OP designation used in Table 5.1 and Table 5.2 can be seen in Figure 5.2.

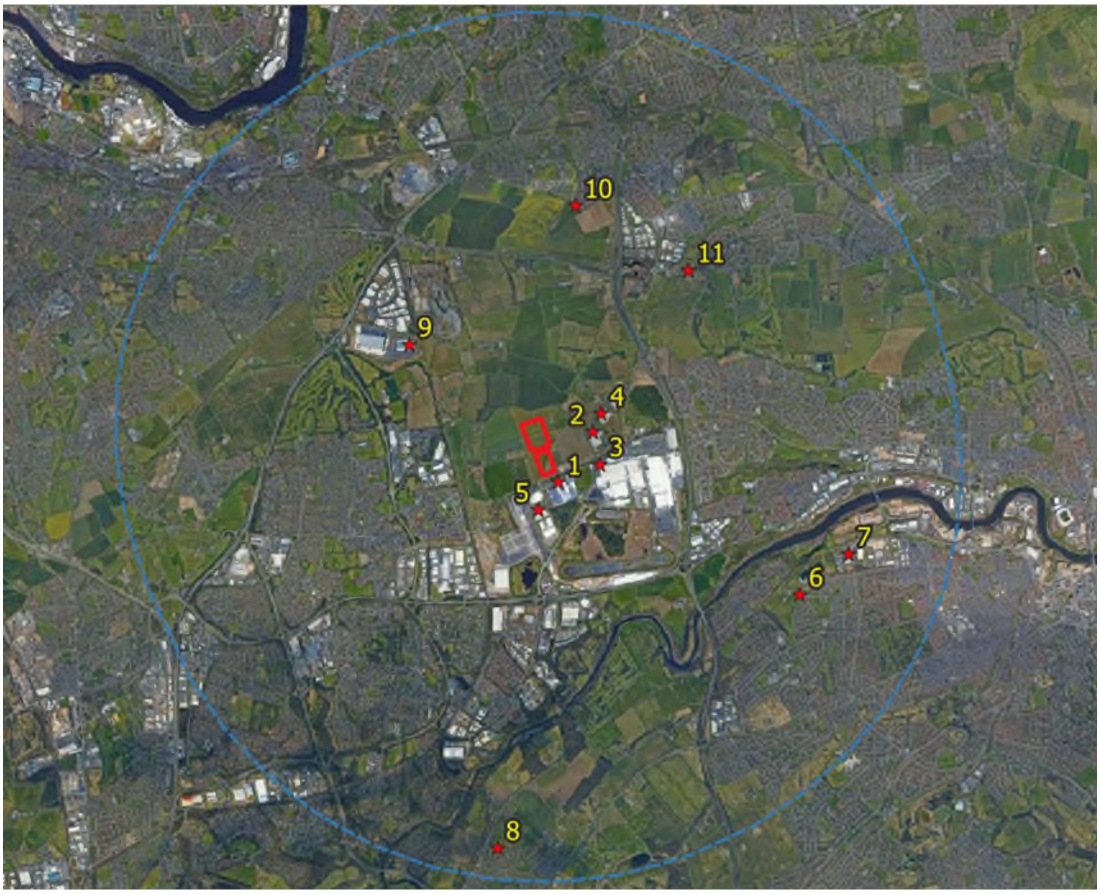

Figure 5.2: OPs (Google 2023)

(Google © 2023, Imagery © 2023 Bluesky, CNES/Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Landsat/Copernicus, Maxar Technologies, The GeoInformation Group)

5.2.6 Local prevailing weather conditions will reduce the extents of the predicted effects, particularly annual durations and is accounted for in Table 5.2. The computer model used is of industry standard, approved and recommended by regulators in the United

States and aviation authorities in the United Kingdom. The model is continuously improved for accuracy, which can show variations in results from historic assessments.

5.2.7 Details of the computer model can be found in Appendix 3.1.4.

Table 5.1: Modelling Results for Local Receptors

OP	Max Annual Duration (mins)	Earliest Start Time	Latest End Time	Earliest Start Date	Latest Finish Date	Site Visibility
OP1	*No glint predicted*					
OP2	6,491	14:37	18:56	22/01/2023	18/11/2023	Y
OP3	6,638	17:05	20:04	22/03/2023	20/09/2023	Y
OP4	6,214	14:21	17:55	12/01/2023	29/11/2023	Y
OP5	*No glint predicted*					
OP6	4,569	19:08	20:17	30/04/2023	13/08/2023	Y
OP7	3,419	18:28	19:38	13/04/2023	29/08/2023	Y
OP8	*No glint predicted*					
OP9	3,773	08:00	09:11	01/01/2023	31/12/2023	Y
OP10	*No glint predicted*					
OP11	6,333	14:02	15:54	01/01/2023	31/12/2023	Y
OP12	*No glint predicted*					
OP13	*No glint predicted*					
OP14	6,883	13:49	16:23	01/01/2024	31/12/2024	Y
OP15	5,113	13:32	15:25	01/01/2024	31/12/2024	Y

5.2.8 It is essential to understand that the modelled results show when glint can occur based on the relative locations of the sun, the panels and receptors. They are provided for information purposes to highlight that even without the consideration of screening, glint can only occur during a highly constricted timeframe. These results do not consider existing or proposed screening, which can limit or eliminate the theoretical results modelled. A detailed discussion of screening implications is provided in the subsequent sections for each OP such that a realistic assessment of glint potential can be established.

Table 5.2: Modelling Results for Local Receptors Including Weather Conditions					
OP	Weather Adjusted Annual Duration (minutes)	Glint Events Proportion of Daylight Hours	Number of Days when Glint might Occur	Maximum Duration of Glint Event (minutes)	Average Duration of Event (min)
OP1	*No glint predicted*				
OP2	1,915	0.72%	194	50	33
OP3	1,959	0.73%	184	48	36
OP4	1,833	0.68%	164	57	38
OP5	*No glint predicted*				
OP6	1,348	0.50%	107	60	43
OP7	1,009	0.35%	97	61	35
OP8	*No glint predicted*				
OP9	1,113	0.41%	135	54	28
OP10	*No glint predicted*				
OP11	1,869	0.69%	111	88	57
OP12	*No glint predicted*				
OP13	*No glint predicted*				
OP14	2,031	0.75%	130	69	53
OP15	1,509	0.56%	85	77	60

5.2.9 As can be seen in Table 5.2Table 5.2, above, that OP3 has the highest exposure to potential glint effects. At OP3, glint is modelled to occur for approximately 0.73% of annual daylight hours. The second highest level of exposure was at OP2, where glint may occur for 0.72% of annual daylight hours. The times and dates when glint events have the potential to occur at the various receptors remain as outlined in Table 5.1.

Observation Point 1

5.2.10 OP1 represents the nearest part of the Unipres complex in the business park that lies just to the south of the site. There is no glint predicted annually at this receptor.

Observation Point 2

5.2.11 OP2 represents SNOP. Adjusting for weather conditions, 1,915 minutes of glint are predicted here annually from January to November. There is very little in the way of screening between the receptor and the proposed development. However, there is no medium intensity glint expected at this OP, meaning there is no potential for temporary after-image.

Observation Point 3

5.2.12 OP3 represents the westernmost part of the Nissan business park, including the sports complex. Adjusting for weather conditions, 1,959 minutes of glint are predicted here annually from March to September. There are trees between this OP and the site that will screen views at ground level and most views at upper levels. Given that views through windows from upper levels would be extremely restricted, glint will not have a material impact on receptors here. Furthermore, all of the glint is predicted to be low intensity (Green).

Observation Point 4

5.2.13 OP4 represents the Faltec building at IAMP. Adjusting for weather conditions, 1,833 minutes of glint are predicted here annually between January and November. There is very little screening in place, however, since the glint is expected to be of a low intensity (Green) there will be no material impact on receptors.

Observation Point 5

5.2.14 OP5 represents the Amazon facility located in the westernmost part of the entire business park that lies just south of the site. There is no glint predicted annually.

Observation Point 6

5.2.15 OP6 represents North View Academy located to the southwest of the development. The entire business park acts as screening, but there will be glimpses of the development in certain places, particularly from the higher stories. Adjusting for weather conditions, 1,348 minutes of glint are predicted here annually from April to August. Given that the views are largely obstructed and that the glint is predicted to be of a low intensity (Green), there will be no material effect on receptors.

Observation Point 7

5.2.16 OP7 represents a Northeast Ambulance Service Depot. The site is located to the southwest of the proposed development. Adjusting for weather conditions, 1,009 minutes of glint are predicted here annually from April to the end of August, occurring in the evenings. There are trees and buildings between this OP and the site that will screen most views. Glint will not have a material impact on receptors, here, due to the low intensity predicted.

Observation Point 8

5.2.17 OP8 represents a cluster of residential properties 5 km south of the development. There is no glint predicted to be received here.

Observation Point 9

5.2.18 OP9 is another Amazon facility located on Follingsbury Ln to the north-west of the development. The site is expected to receive 1,113 minutes of glint annually when weather conditions have been considered. There are some trees screening the OP from the development, but this will not provide comprehensive screening. Meaning visibility is still expected. The glint predicted is expected to be low intensity (Green) and, therefore, glint will not have a material impact on receptors here.

Observation Point 10

5.2.19 OP10 represents a cluster of residential properties directly north of the development in Fellgate. There is no glint predicted for this OP.

Observation Point 11

5.2.20 OP11 represents a cluster of properties located just off the A184 in West Boldon due north-east of the development. There is some screening in the form of trees between the receptor and the development, but due to the height of the development, visibility is still expected. Adjusting for weather conditions, 1,869 minutes of glint are predicted here annually from January to December. Also, given the low intensity, glint will not have a material impact on receptors, here.

Observation Point 12

5.2.21 OP12 represents Strother House Farm which is situated to the north of the Site on Follingsby Lane. There is no glint predicted at this receptor.

Observation Point 13

5.2.22 OP13 represents Mypetstop which is situated next to OP12, to the north of the Site on Follingsby Lane. There is no glint predicted at this receptor.

Observation Point 14

5.2.23 OP13 represents Hylton Bridge Farm, to the northeast of the Site on Follingsby Lane. This receptor is expected to receive approximately 2,031 minutes of glint annually after weather conditions have been considered. There are some trees screening the OP from the proposed development, but this is unlikely to provide comprehensive screening so there could still be some visibility. However, the glint predicted is expected to be low intensity (Green) glint and, therefore, will not have a material impact on the receptor.

Observation Point 15

5.2.24 OP13 represents Hylton Grove Farm, adjacent to OP12 to the northeast of the Site on Follingsby Lane. This receptor is expected to receive approximately 1,509 minutes of green glint a year after weather conditions have been considered. As the glint predicted is expected to be of low intensity, it will not have a material impact on this receptor.

Local Properties Conclusion

5.2.25 The analysis has shown that there is potential for some local properties receive glint. Where views of the site exist, this is more likely to be from buildings' upper floors, where the potential for glint will not have a large impact on receptors. All of the glint observed is predicted to be of low intensity (Green) meaning there is a low potential for temporary after-image. Any glimpses of glint would be no worse than viewing a sunlight reflection from window glass similar to those used in glasshouses or still water.

5.3 Effect on National Trails and Paths

5.3.1 The nearest national trail is the Northeast England Coast Path in Sunderland, which is over 6km away, and will not be affected by these proposed solar arrays. Five PRoW were identified in the vicinity of the array shown in Figure 5.3, below.

Figure 5.3: Public Rights of Way in Vicinity of Site

(Google Earth, Imagery © 2024 Bluesky, CNES/Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Landsat/Copernicus, Maxar Technologies, The GeoInformation Group)

5.3.2 After analysis, only low intensity green glint was predicted at all of the PRoW. From aerial photography, all PRoWs will also be largely screened by intervening trees and hedgerows. Given that PRoW users will primarily be on foot, and limited visibility to panels will exist, glint is not expected to compromise safety or have a material impact on use of the PRoWs.

5.4 Effect on Public Roads

5.4.1 There are several roads within the study area. There are no motorways with the potential to receive glint. Motorists are, as a matter of routine, used to driving towards the sun, which provides a much more intense source of light than glint. Notwithstanding this, roads within the immediate vicinity of the site have been assessed for glint effects.

5.4.2 Stretches of road within ZTV have been identified and representative observation points selected for computer simulation. Although the dates and times when glint has the potential to be visible for specific stretches of the road may vary, the results reported are expected to be representative of the road in general. The dates and times reported are the extents of when glint could be geometrically possible, but glint would not necessarily occur continuously during that period.

5.4.3 Each road that has been assessed is shown in Figure 5.4. All the roads modelled are at least partially or completely within the ZTV. Motorists on roads that are not in the ZTV will not experience glint events.

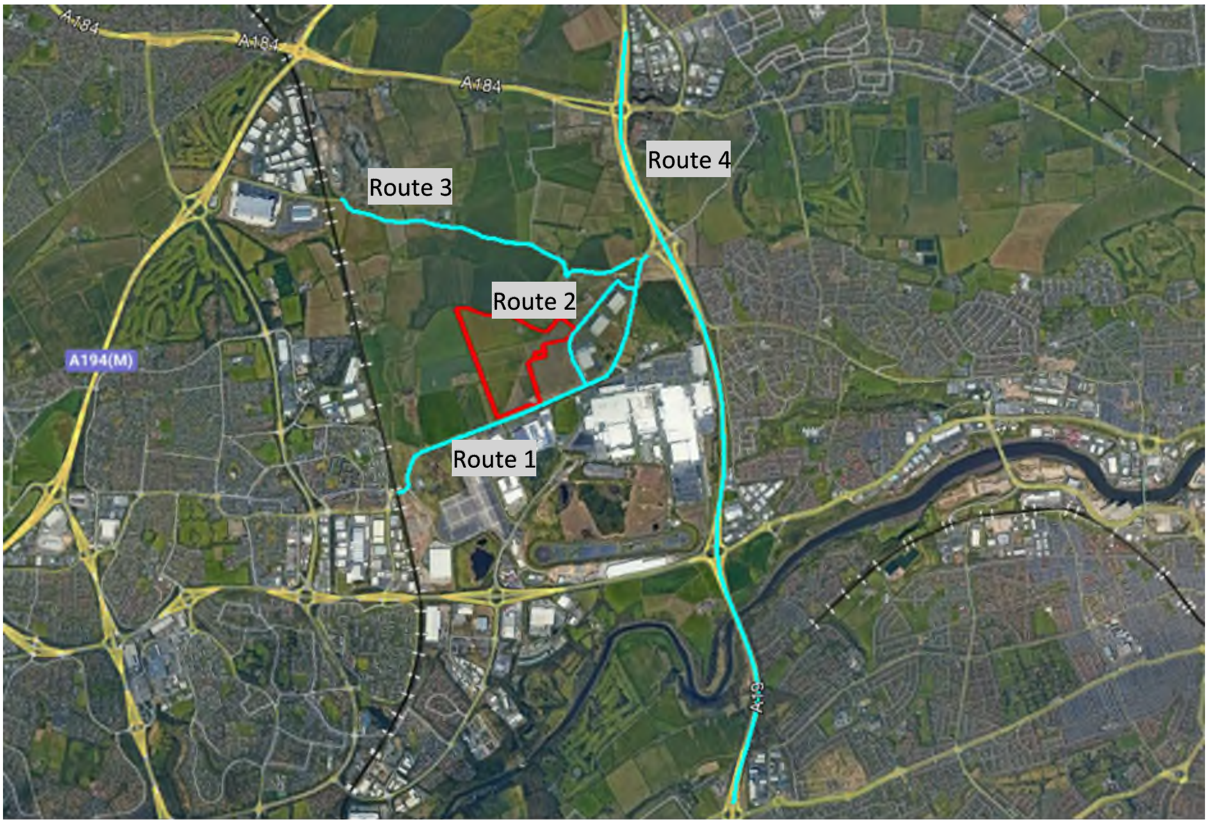

Figure 5.4: Routes with the potential to receive glint

(Extract from ForgeSolar 2023, Imagery © 2023 Bluesky, CNES/Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Landsat/Copernicus, Maxar Technologies, The GeoInformation Group)

A1290 (Route 1)

5.4.4 The A1290 runs along the southern boundary of the site. Most of the site will be screened to motorists at the sections of the road further away from the immediate vicinity of the site. At the section of the road that runs directly adjacent to the site, there will be visibility to the proposed building structure. However, at this distance, motorists will be too close to the building to experience glint effects or see the panels on the roof. There is no screening along this section of the road, but there is no risk of glint due to the heights of the sections of the buildings.

5.4.5 This road is predicted 7,775 minutes of glint annually (weather adjusted) throughout the year, of which 1,457 minutes will be medium intensity glint with some potential for temporary after image (yellow glint). Since there will be no direct line of sight between the receptor and the panels, there is a very slim chance of drivers being exposed to the moderate intensity glint.

5.4.6 The only location where any medium intensity yellow glint is predicted on the A1290. Only four (4) of the twenty (20) sections used to model the panels are responsible for this moderate intensity glint. These sections are:

- PVC East L – 674 minutes of yellow glint predicted annually before climatic conditions are considered. This is predicted to occur between the start of May and the end of August. Yellow glint will take place between 19:30 and 21:00. The stretch of road affected by this glint is shown in Figure 5.5**Error! Reference source not found.**. The AESC Plant 2 development will screen these panels and prevent road users from experiencing glint from these panels.

- PW East L – 3,271 minutes of yellow glint predicted annually before climatic conditions are considered. This is expected to take place between March and the end of May and resumes between July and September. The glint takes place between 18:00 and 21:00. The stretch of road affected by this glint is shown in Figure 5.4. The AESC Plant 2 development will screen these panels and prevent road users from experiencing glint from these panels.

- PW West H – 923 minutes of yellow glint predicted annually before climatic conditions are considered. This moderate intensity glint will start in mid-May and finish in late July. This is unlikely to cause issues as the glint is predicted to take place between 05:00 and 06:00 at which time the road will be quiet. The western stretch of road is affected by this moderate intensity glint as shown in Figure 5.5. From this section of road, the panels will be screened by the PW West arrays located in between the two. This means that there will be no line of sight to the panels responsible for producing the moderate intensity glint.

- PW West L – 71 minutes of yellow glint predicted annually before climatic conditions are considered. The entirety of this yellow glint occurs in June and is expected to take place at 06:00. The western stretch of road is affected by this moderate intensity glint, from this section of road, the panels will be screened by the PW West located in between the two. As before, the western stretch of road is affected by this moderate intensity glint, from this section of road, the panels will be screened by the PW West arrays located in between the two. This means that there will be no line of sight to the panels responsible for producing the moderate intensity glint.

5.4.7 The location of this glint is condensed to the straight section of road running adjacent to the proposed development. Along this stretch of the road, visibility to the panels will likely be obscured by the building itself and the viewing angle that would be required to see that height above the ground.

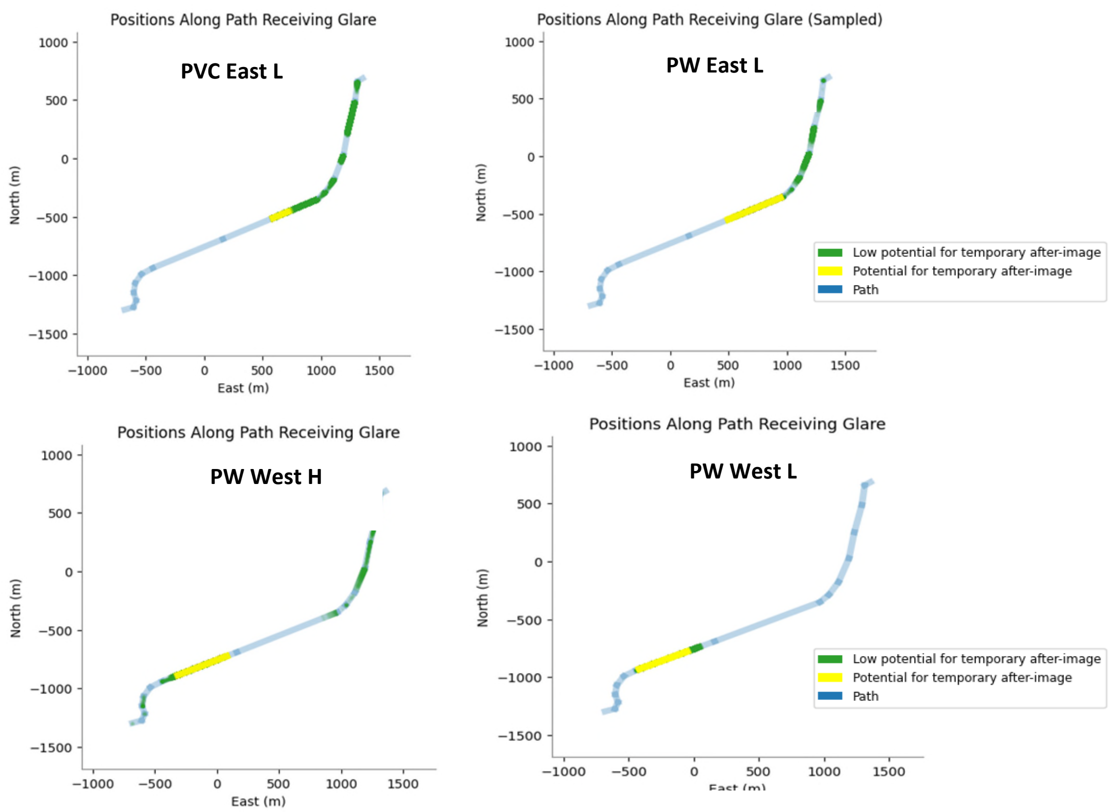

Figure 5.5: Positions on Route 1 Predicted to Experience Glint

(Extract for Forge Solar © 2023)

5.4.8 Given the limited potential for passing motorists to see the panels, the short (if any) duration of medium intensity glint that could be experienced and the fact that (even if it is visible), because of the proximity of the roof the source of the glint would appear to be in the sky (where the sun might appear) and out of the normal field of view of a driver concentrating on the road, there is not expected to be a tangible risk to the safety of road users on this road.

International Drive (Route 2)

5.4.9 A large portion of the development will be screened by the AESC Plant 2 development, reducing any visibility to panels form the road. The road is predicted to receive 5,229 minutes of glint annually (weather adjusted). All of the glint predicted for this road is 'green' meaning there is low potential to cause temporary after image.

Follingsby Ln (Route 3)

5.4.10 This road runs to the north of the site. It is partially screened by hedgerows but will have visibility to the array. This road is predicted 5,638 minutes of glint annually (weather adjusted). All glint predicted on this road is Green, meaning that it has a low potential to cause a temporary after-image. Furthermore, the view from the road to the development will be intermittent due to roadside screening.

5.4.11 Given that the panels will be tilted at a relatively shallow angle, more intense sunlight during the summer will be reflected upwards. When glint does occur, road users will not directly face the site while they are moving. Glint will be less intense than direct sunlight, which motorists routinely experience.

A19 (Route 4)

5.4.12 This road runs to the east of the site. There are trees and hedgerows between the road and the development, but this will be insufficient to comprehensively screen the development. The industrial park will screen the development largely from the south. Owing to the lack of sufficient screening, the development will be visible to southbound road users. The development will not be in the direct line of sight to motorists and the glint will only be experienced for a short period of time.

5.4.13 This road is predicted 1,886 minutes of glint annually (weather adjusted) throughout the year. All of the glint predicted for this road is Green, meaning that there is a low potential for road users to experience a temporary after image.

Public Roads Conclusion

5.4.14 The analysis has shown that there is low potential for roads to receive glint. In most cases, roads are well screened by existing screening. Motorists on roads that are not completely screened are unlikely to be affected by glint as the duration will be short and the glint intensity will be low. The only route predicted to experience any medium intensity glint (Route 1, A1290) will have limited visibility to the panels and it would be out of the normal line of sight for a driver concentrating on the road, coming from a skyward position. It is, therefore, not expected to pose a tangible risk to the safety of road users, who will be experienced driving in conditions when the sun (a far more intense light source) may appear low in the sky.

5.5 Effect on Railways

5.5.1 The Tyne and Wear Metro Green Line runs 4km from the site, at its closest point. The stretch that lies in the ZTV is predicted to experience 1,522 minutes of low intensity Green glint (weather adjusted) in the evenings between April and July. This glint is considered not to be material. No other railway lines were identified within 5km of the site.

5.6 Effect on Airfields & Aircraft

5.6.1 There are concerns that glint could have a negative effect on both airport and aircraft operations while on the ground and on aircraft flying over or near to the site. The nearest major airport to the site is Newcastle International Airport, which lies 20km to the northwest. After analysis, no glint was predicted from the proposed PV arrays on final approach.

5.6.2 The closest small aerodrome is the High Flatts Farm Airstrip, located at Pelton, approximately 9km southwest of the proposed development. Approach paths to this grass strip have been assessed and, whilst a small amount of Green glint is predicted, no Yellow glint is shown to be visible to pilots landing. As such, any effects are not material.

5.6.3 No other airfields operate within 15km of the site and, as such, there will be no effect visible to pilots during critical flight times (final approach). Although glint could be visible to overflying light aircraft, any effect visible would not be sustained for extended durations and would be orders of magnitude lower than large bodies of still water.

5.7 Cumulative Effects

5.7.1 There are several other sources of reflection in the vicinity of the proposed development, so there is a potential for cumulative glint effects to be received by receptors surrounding the site. This (cumulative effects) section addresses any potential cumulative glint effect that may arise from existing and proposed sites together with this site.

5.7.2 Figure 5.6 shows a chart for an illustrative OP demonstrating the timings of cumulative effects. The geometric potential for glint associated with the proposed development, as described in Section 5.2, is shown in orange. Cumulative effects include the glint associated with both the proposed development and existing sites (grey). Simultaneous cumulative effects have the potential to occur when the times and dates when glint is possible, overlap between the arrays, as shown in Figure 5.6 in yellow.

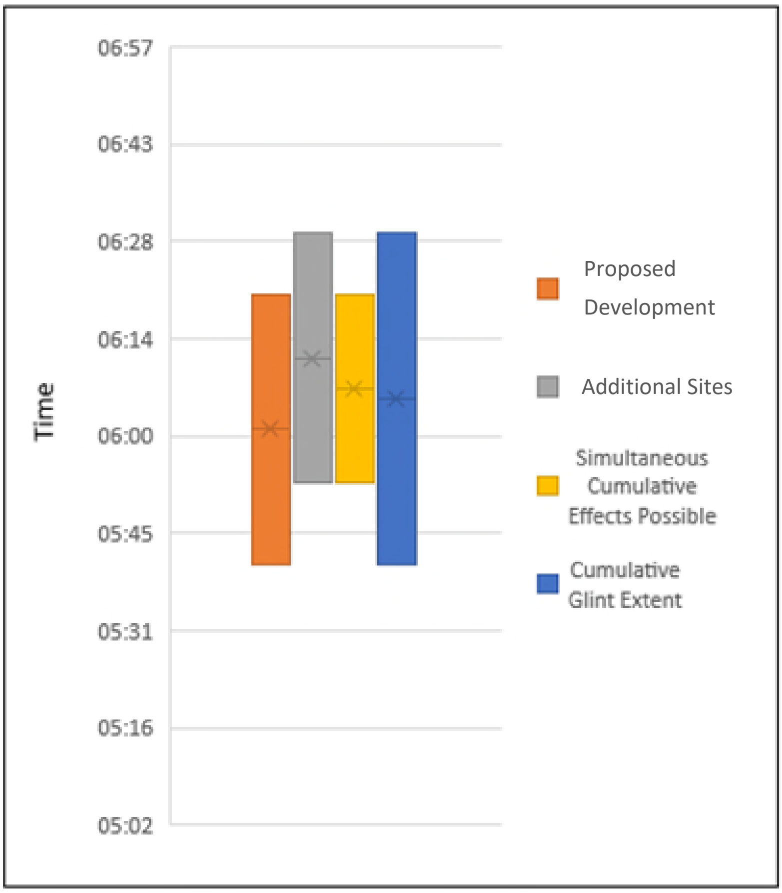

Figure 5.6: Example Chart Representation of Simultaneous Cumulative Effects

5.7.3 Only simultaneous cumulative effects will be considered as this is when glint is more intense in a particular location. Furthermore, material cumulative effects are considered to only occur where medium intensity glint, with some potential for temporary after image, is predicted to arise from the proposed development. In the case where only low intensity, non-material glint is predicted from the proposed development, cumulative effects are not expected to be 'substantially' elevated above the baseline levels without the proposed development and, hence, the cumulative effect is considered to be minimal.

5.7.4 A number of solar arrays were identified in the vicinity of the Proposed Development. These include, but are not limited to, those shown in **Error! Reference source not found.**, below.

Table 5.3: Main Cumulative Sites

Ref No.	Type	Description	Status	Location	Cum. Glint
Site: AESC Plant 2					
21/01764/ HE4	Full	Erection of industrial unit to be used for the manufacture of batteries for vehicles with ancillary office / welfare floorspace and associated infrastructure provision, accesses, parking, drainage and landscaping.	The revised IAMP ONE Phase Two Development planning application (ref. no. 21/01764/HE4) was submitted to SCC in July 2021 and planning consent was granted in October 2021. Due to operational requirements, the Applicant is now proposing several amendments to the approved facility to help improve health and safety.	Adjacent to/ within the Site	Screening present, and where cumulative glint is possible, there is no risk to health and safety.
Site: Nissan Motor Manufacturing (UK) Ltd					
15/00942/ FUL	Full	Construction, Operation and Decommissioning of a 4.774MWp Solar Photovoltaic (PV) Array comprising 19,096, 250W, 60 Cell 1650 x 990 x 35mm Photovoltaic Panels, Mounting System, Holtab 400kVA stations, DNO Connection, Cabling and Cable Trenches, CCTV, Weather Station and Temporary Storage Area.	Approved July 2015 (Completed)	To the southeast of the site boundary	South-facing panels will only be capable of reflecting glint to southeast and southwest of the installation. Therefore, only receptors located to the south of these panels have any potential for cumulative glint. No cumulative effects predicted.
Site: Vantec, Turbine Way					
23/00805/ PCZ	Prior Approval	Installation of roof mounted solar PV system (320.76 kWp), consisting of 703 solar modules alongside 2x 110kW inverters.	Submitted March 2023 (Pending Consideration)	To the southeast of the site boundary.	Screening present from trees and Nissan buildings between the Site. No cumulative effects predicted.
Site: Kasai UK Ltd, Factory 1, Stephenson Road, Stephenson, Washington					
22/02538/ FUL	Full	Installation of 1,450kWp solar system on main factory roof. 3540 panels in total.	Submitted March 2023 (Pending Consideration)	Located to the northwest of the site boundary	Screening present from other industrial buildings and trees to east. No cumulative effects predicted.

Site: Griffiths Textiles Machines, Alston Road, North Washington					
22/01039/ PCZ	Prior Approval	Installation of 707kWp PV solar panels to roof.	Decision Issued September 2022	2.65 km to the southwest of the site boundary..	Location to south of A1231 with arrays screened by other buildings and trees lining the A-road. No cumulative effects predicted.

5.7.5 Prior to considering the effects of screening, only Route 1 (A1290) was predicted to be capable of receiving medium intensity glint from the proposed development. Since the panels are expected to be screened, it is not possible for cumulative glint to be experienced along this route.

5.7.6 The panels that are proposed on AESC Plant 2 are predicted to produce medium intensity glint at Route 1. Wardell Armstrong authored the glint assessment for the panels on the roof at AESC Plant 2. The report concluded that visibility to the panels was limited and any effects would come from a skyward position so it would be out of the normal line of sight for a driver concentrating on the road. It was therefore not expected to pose a tangible risk to the safety of road users, who out of necessity should be experienced driving in a wide range of lighting conditions, including when the sun (a far more intense light source) appears low in the sky.

5.7.7 As that report concluded that glint from AESC Plant 2 will either not be visible or not provide a risk to safety along the extent of the route receptor, there is no risk of cumulative glint providing a greater risk. The modelling for AESC Plant 3 predicts potential for similar glint effects at Route 1, however, only if those panels can be seen. The two sets of roof top arrays cannot have cumulative effects with one another, if the panels on both roofs are not simultaneously visible and producing glint, or if the levels of glint predicted are deemed to be insufficient to present any risk. As it has also been concluded that the panels on the AESC Plant 3 site will have virtually no visibility along this section of road, there will be no cumulative glint effects.

5.7.8 Several other rooftop arrays have been identified in the area, including on the Unipres building to the south of the proposed development and the A1290. However, due to the use of parapets and other screening measures, none of these are expected to have cumulative effects with Route 1.

6 CONCLUSIONS

6.1.1 This report seeks to demonstrate the possible effects that reflected sunlight from a proposed roof mounted solar array would have on receptors in the vicinity of the proposed development. These receptors include residential properties, road, rail, air traffic and national trails. The methodology employs the use of:

- a ZTV to identify whether local topography screens those receptors;
- a computer model to determine the times, dates and duration that glint may theoretically be visible; and,
- a discussion of screening such that a realistic assessment of potential effects can be made.

6.1.2 The reflectivity of solar panels is considerably less than many other common materials seen in the built or natural environment. Water bodies, such as reservoirs, lakes and (on a calm day) the ocean have very similar reflective properties to solar panels and represent much larger areas than that taken up by the solar panels at the site. In any case, **the overall potential for glint at receptors within the vicinity of the site is low**.

6.1.3 The A1290 is the only route predicted to be capable of experiencing any medium intensity Yellow glint (i.e. some potential for temporary after image). This glint will be screened the AESC Plant 2 development, by the roof, itself, and the proximity of the road to the building. Any glint would originate from high up and would not be in the direct view of drivers concentrating on the road. Drivers are accustomed to driving in conditions where the sun is low in the sky, and this is far more intense than glint from panels. **It is not expected that this glint will pose a risk to road safety.**

6.1.4 Both Follingsby Lane and the A19 are predicted to receive glint due to lack of complete screening. **Glint will not pose a material risk to motorists as it is all of a low intensity**. Anti-reflective measures are recommended, however, for north-facing solar panels.

6.1.5 **Only minor Green glint was predicted on the final approach to High Flatts Farm airstrip; no glint was predicted on local footpaths.**

6.1.6 **No cumulative, simultaneous glint from existing sites was predicted for receptors with potential to receive glint from the proposed development.**

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Appendix 3.1.1

Policy & Guidance

APPENDIX 3.1.1 POLICIES AND GUIDANCE

LEGISLATIVE FRAMEWORK

The applicable legislation includes:

- National Planning Policy Framework (December 2023)
- Planning Practise Guidance

National Planning Policy Framework (December 2023)[1]

The National Planning Policy Framework (NPPF) is intended for applications submitted under the Town and Country Planning Regulations and provides a strategic framework for considering planning applications.

Specific guidance on solar PV is limited, and there is no direct mention of glint, but Paragraph 163 states:

"When determining planning applications for renewable and low carbon development, local planning authorities should:

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions;
b) approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas, and
c) in the case of applications for the repowering and life-extension of existing renewable sites, give significant weight to the benefits of utilising an established site, and approve the proposal if its impacts are or can be made acceptable.

National Planning Practice Guidance (NPPG)

The National Planning Practice Guidance (NPPG) planning practice guidance sets out guidance for large ground mount solar farms under the section entitled 'Renewable and Low Carbon Energy'.

[1] Department for Levelling Up, Housing and Communities (December 2023) 'National Planning Policy Framework'. Available at: National Planning Policy Framework (publishing.service.gov.uk)

Paragraph 013 states:

"What are the particular planning considerations that relate to large scale ground-mounted solar photovoltaic Farms?"

"The deployment of large-scale solar farms can have a negative impact on the rural environment, particularly in undulating landscapes. However, the visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively.

"Particular factors a local planning authority will need to consider include [inter alia]:

- *the proposal's visual impact, the effect on landscape of glint and glare (see guidance on landscape assessment) and on neighbouring uses and aircraft safety;*
- *the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun;*
- *the potential to mitigate landscape and visual impacts through, for example, screening with native hedges;*

"The approach to assessing cumulative landscape and visual impact of large scale solar farms is likely to be the same as assessing the impact of wind turbines. However, in the case of ground-mounted solar panels it should be noted that with effective screening and appropriate land topography the area of a zone of visual influence could be zero."

Due to the scale of this application, the Proposed Development will be determined by the Local Planning Authority under the Town and Country Planning Regulations rather than as a Nationally Significant Infrastructure Project, which would instead be considered by the Secretary of State through the Development Consent Order process. Nevertheless, it is relevant to consider guidance for larger renewable energy projects contained in the emerging National Policy Statements, which still carry weight as material guidance.

Planning Policy

Emerging 'Overarching National Policy Statement for Energy' (NPS EN-1) – November 2023[2]

EN-1 recognises that there is significant need to increase the penetration of renewables in the UK generation mix. Paragraph 3.3.1 states:

"Electricity meets a significant proportion of our overall energy needs and our reliance on it will increase as we transition our energy system to deliver our net zero target. We need to ensure that there is sufficient electricity to always meet demand; with a margin to accommodate unexpectedly high demand and to mitigate risks such as unexpected plant closures and extreme weather events."

It continues in paragraph 3.3.13, under the heading 'Delivering affordable decarbonisation':

"The Net Zero Strategy sets out the government's ambition for increasing the deployment of low carbon energy infrastructure consistent with delivering our carbon budgets and the 2050 net zero target. This made clear the commitment that the cost of the transition to net zero should be fair and affordable."

In Paragraph 3.3.20 it says:

"Wind and solar are the lowest cost ways of generating electricity, helping reduce costs and providing a clean and secure source of electricity supply (as they are not reliant on fuel for generation). Our analysis shows that a secure, reliable, affordable, net zero consistent system in 2050 is likely to be composed predominantly of wind and solar."

Paragraph 3.3.59, under the heading 'The need for electricity generating capacity' states:

"All the generating technologies mentioned above are urgently needed to meet the government's energy objectives by:

- *providing security of supply (by reducing reliance on imported oil and gas, avoiding concentration risk and not relying on one fuel or generation type)*
- *providing an affordable, reliable system (through the deployment of technologies with complementary characteristics)*

[2] Department for Energy Security & Net Zero (November 2023), 'Overarching National Policy Statement for Energy (EN-1)'. Available at: EN-1 Overarching National Policy Statement for Energy (publishing.service.gov.uk)

- *ensuring the system is net zero consistent (by remaining in line with our carbon budgets and maintaining the options required to deliver for a wide range of demand, decarbonisation and technology scenarios, including where there are difficulties with delivering any technology)"*

Under the heading 'Bringing forward new electricity infrastructure projects', Paragraphs 3.3.82 - 3.3.83 go on to say:

"Government has committed to reduce GHG emissions by 78 per cent by 2035 under carbon budget 6. According to the Net Zero Strategy this means that by 2035, all our electricity will need to come from low carbon sources, subject to security of supply, whilst meeting a 40-60 per cent increase in demand.

"Given the urgent need for new electricity infrastructure and the time it takes for electricity NSIPs to move from design conception to operation, there is an urgent need for new (and particularly low carbon) electricity NSIPs to be brought forward as soon as possible, given the crucial role of electricity as the UK decarbonises its economy."

In respect of civil and military aerodromes, EN-1 comments in Section 5.5.5:

"UK airspace is important for both civilian and military aviation interests. It is essential that new energy infrastructure is developed collaboratively alongside aerodromes, aircraft, air systems and airspace so that safety, operations and capabilities are not adversely affected by new energy infrastructure.

"...The approaches and flight patterns to aerodromes can be irregular owing to a variety of factors including the performance characteristics of the aircraft concerned and the prevailing meteorological conditions. It may be possible to adapt flight patterns to work alongside new energy infrastructure without impacting on aviation safety."

The subsection 'Safeguarding' continues from Paragraph 5.5.8:

"Certain civil aerodromes, and aviation technical sites, selected on the basis of their importance to the national air transport system, are officially safeguarded in order to ensure that their safety and operation are not compromised by new development.

"A similar official safeguarding system applies to all military aerodromes, defence surveillance sites, and other defence assets.

"Areas of airspace around aerodromes used by aircraft, including taking off or on approach and landing are described as "obstacle limitation surfaces" (OLS). All civil aerodromes licensed by the Civil Aviation Authority (CAA) and all military aerodromes must comply with the OLS. These are defined according to criteria set out in relevant CAA guidance for licensed civil aerodromes and according to MOD criteria, as set by the Military Aviation Authority, which is part of the Defence Safety Authority (DSA), for military aerodromes.

"Aerodromes that are officially safeguarded will have officially produced plans that show the OLS. Care must be taken to ensure that new developments do not infringe these protected OLS, as these encompass the critical airspace within which key air traffic associated with the aerodrome operates.

"The CAA's CAP 738 sets out that all licensed aerodromes are required to ensure they have a system in place to safeguard their aerodrome against the growth of obstacles or activities that may present a hazard to aircraft operations.

"It is considered best practice for the LPA to include the safeguarded area and explanatory notes on its planning 'constraints' plan so that potential applicants can be aware of the presence of the aerodrome and the extent and nature of the safeguarding relevant to a particular aerodrome. DfT/ODPM Circular 01/2003 provides advice to planning authorities on the official safeguarding of aerodromes and includes a list of the civil aerodromes which are officially safeguarded.

"The DfT/ODPM Circular 01/2003 and CAA guidance also recommends that the operators of aerodromes which are not officially safeguarded should take steps to protect their aerodrome from the possible effects of development by establishing an agreed consultation procedure between themselves and the LPAs.

"The certified Safeguarding maps for all aerodromes (both licensed and unlicensed) depicting the OLS and other criteria (for example to minimise "birdstrike" hazards) are deposited with the relevant LPAs.

"The CAA makes clear that the responsibility for the safeguarding of General Aviation aerodromes lies with the aerodrome operator."

Whilst not specifically glint related, in talking about 'artificial light', Section 5.7.1 mentions:

"During the construction, operation and decommissioning of energy infrastructure there is potential for the release of a range of emissions such as odour, dust, steam, smoke, artificial

light and infestation of insects. All have the potential to have a detrimental impact on amenity or cause a common law nuisance or statutory nuisance under Part III, Environmental Protection Act 1990. However, they are not regulated by the environmental permitting regime, so mitigation of these impacts will need to be included in the Development Consent Order.

"Because of the potential effects of these emissions and infestation, and in view of the availability of the defence of statutory authority against nuisance claims described in Section 4.15, it is important that the potential for these impacts is considered by the applicant and Secretary of State."

"The applicant should assess the potential for insect infestation and emissions of odour, dust, steam, smoke, and artificial light to have a detrimental impact on amenity, as part of the ES."

"The applicant is advised to consult the relevant local planning authority and, where appropriate, the EA about the scope and methodology of the assessment."

Section 5.9 deals with Landscape and Visual Effects, and paragraph 5.10.21 mentions:

"The assessment should include the visibility and conspicuousness of the project during construction and of the presence and operation of the project and potential impacts on views and visual amenity. This should include light pollution effects, including on local amenity, and nature conservation."

"The assessment should also demonstrate how noise and light pollution, and other emissions (see Section 5.2 and Section 5.7), from construction and operational activities on residential amenity and on sensitive locations, receptors and views, will be minimised."

Paragraph 5.10.26 continues:

"Reducing the scale of a project can help to mitigate the visual and landscape effects of a proposed project. However, reducing the scale or otherwise amending the design of a proposed energy infrastructure project may result in a significant operational constraint and reduction in function - for example, the electricity generation output. There may, however, be exceptional circumstances, where mitigation could have a very significant benefit and warrant a small reduction in function. In these circumstances, the Secretary of State may decide that the benefits of the mitigation to reduce the landscape and/or visual effects outweigh the marginal loss of function."

Paragraph 5.10.28 goes on to say:

"Depending on the topography of the surrounding terrain and areas of population it may be appropriate to undertake landscaping off site. For example, filling in gaps in existing tree and hedge lines would mitigate the impact when viewed from a more distant vista."

In Section 5.14 EN-1 discusses transport impacts:

"If a project is likely to have significant transport implications, the applicant's ES (see Section 4.3) should include a transport appraisal. The DfT's Transport Analysis Guidance (TAG) and Welsh Governments WelTAG provides guidance on modelling and assessing the impacts of transport schemes.

"Applicants should consult National Highways and Highways Authorities as appropriate on the assessment and mitigation to inform the application to be submitted."

National Policy Statement for Renewable Energy (NPS EN-3) – November 2023[3] (in force 17th January 2024)

Section 2.10 is entitled 'Solar Photovoltaic Generation'. Paragraph 2.10.9 states:

"The government has committed to sustained growth in solar capacity to ensure that we are on a pathway that allows us to meet net zero emissions. As such solar is a key part of the government's strategy for low-cost decarbonisation of the energy sector.

"Solar also has an important role in delivering the government's goals for greater energy independence and the British Energy Security Strategy states that government expects a five-fold increase in solar deployment by 2035 (up to 70GW). It sets out that government is supportive of solar that is co-located with other functions (for example, agriculture, onshore wind generation, or storage) to maximise the efficiency of land use."

Under the heading 'Proximity of a site to dwellings', Paragraph 2.10.27 states:

"Utility-scale solar farms are large sites that may have a significant zone of visual influence. The two main impact issues that determine distances to sensitive receptors are therefore likely to be visual amenity and glint and glare..."

Paragraphs 2.10.94 and 2.10.95 relate to landscape, visual and residential amenity, and continue:

"...Solar farms are likely to be in low lying areas of good exposure and as such may have a wider zone of visual influence than other types of onshore energy infrastructure.

[3] Department for Energy Security & Net Zero (November 2023), 'National Policy Statement for Renewable Energy Infrastructure (EN-3)'. Available at: National Policy Statement for Renewable Energy Infrastructure (EN-3) (publishing.service.gov.uk)

"However, whilst it may be the case that the development covers a significant surface area, in the case of ground-mounted solar panels it should be noted that with effective screening and appropriate land topography, the area of a zone of visual influence could be appropriately minimised."

Under the subsection 'Glint and Glare', specific guidance is given from Paragraph 2.10.102:

"Solar panels are specifically designed to absorb, not reflect, irradiation[4]. However, solar panels may reflect the sun's rays at certain angles, causing glint and glare. Glint is defined as a momentary flash of light that may be produced as a direct reflection of the sun in the solar panel. Glare is a continuous source of excessive brightness experienced by a stationary observer located in the path of reflected sunlight from the face of the panel. The effect occurs when the solar panel is stationed between or at an angle of the sun and the receptor.

"Applicants should map receptors to qualitatively identify potential glint and glare issues and determine if a glint and glare assessment is necessary as part of the application.

"When a quantitative glint and glare assessment is necessary, applicants are expected to consider the geometric possibility of glint and glare affecting nearby receptors and provide an assessment of potential impact and impairment based on the angle and duration of incidence and the intensity of the reflection.

"The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and design. This may need to account for 'tracking' panels if they are proposed as these may cause differential diurnal and/or seasonal impacts.

"When a glint and glare assessment is undertaken, the potential for solar PV panels, frames and supports to have a combined reflective quality may need to be assessed, although the glint and glare of the frames and supports is likely to be significantly less than the panels."

In relation to mitigation, Paragraphs 2.10.134-2.10.136 state:

"Applicants should consider using, and in some cases the Secretary of State may require, solar panels to comprise of (or be covered with) anti-glare/anti-reflective coating with a specified angle of maximum reflection attenuation for the lifetime of the permission.

"Applicants may consider using screening between potentially affected receptors and the reflecting panels to mitigate the effects.

"Applicants may consider adjusting the azimuth alignment of or changing the elevation tilt angle of a solar panel, within the economically viable range, to alter the angle of incidence. In practice this is unlikely to remove the potential impact altogether but in marginal cases may contribute to a mitigation strategy."

Concerning the Impacts of Solar PV, Paragraphs 2.10.158-2.10.159 continue:

[4] Most commercially available solar panels are designed with anti-reflective glass or are produced with anti-reflective coating and have a reflective capacity that is generally equal to or less hazardous than other objects typically found in the outdoor environment, such as bodies of water or glass buildings.

"Solar PV panels are designed to absorb, not reflect, irradiation. However, the Secretary of State should assess the potential impact of glint and glare on nearby homes, motorists, public rights of way, and aviation infrastructure (including aircraft departure and arrival flight paths).

Whilst there is some evidence that glint and glare from solar farms can be experienced by pilots and air traffic controllers in certain conditions, there is no evidence that glint and glare from solar farms results in significant impairment on aircraft safety. Therefore, unless a significant impairment can be demonstrated, the Secretary of State is unlikely to give any more than limited weight to claims of aviation interference because of glint and glare from solar farms."

GUIDANCE

BRE: Site Layout Planning for Daylight and Sunlight: A guide to good practice

In the UK at the domestic level the closest guidelines regarding glint are the BRE guidelines on 'Site layout planning for Daylight and Sunlight'[5]

With regard to solar dazzle these state that:

"Glare or dazzle can occur when sunlight is reflected from a glazed façade or an area of metal cladding. This can affect road users outside and the occupants of adjoining buildings. The problem can occur where there are large areas of reflective glass or cladding on the façade, or where there are areas of glass or cladding slope back so that high altitude sunlight can be reflected along the ground. Thus solar dazzle is only a long-term problem for some heavily glazed (or mirror clad) buildings. Photovoltaic panels tend to cause less dazzle because they are designed to absorb light.

If it is likely that a building may cause solar dazzle the exact scale of the problem should be evaluated. This is done by identifying key locations such as road junctions and windows of nearby buildings, and working out the numbers of hours of the year that sunlight can be reflected to these points. BRE information paper IP 3/87 gives details.

Glare to motorists approaching the building can be an issue. The worst problems occur when drivers are travelling directly towards the building and sunlight can reflect off surfaces in the drivers direct line of sight (usually this will be off the lower parts of the building)."

After setting out a methodology for calculating solar reflections from sloping glazed facades, BRE information paper IP 3/872 summarises effects as follows:

"Initial experience suggests that, in Europe and the USA at least, the greatest problems occur with facades facing within 90o of due south, sloping back at angles between 5o and 30o to the vertical. Where the façade slopes at more than 40o to the vertical (less than 50o to the horizontal) solar reflections are likely to be less of a problem, unless nearby buildings are very high; and facades which slope forward, so that the top of the building forms an effective overhang, should also cause few problems in this respect. In the northern hemisphere, north

[5] Site Layout Planning for Daylight and Sunlight: A guide to good practice. (2nd Edition) Paul Littlefair, BRE Trust, First published 2011.

facing facades should only cause reflected solar glare on a few occasions during the year, if at all."

In the domestic setting the guidelines therefore suggest that glare and dazzle are only likely to be issues if the facade (or panel in this case) is within 40 degrees of the vertical or 50 degrees of the horizontal. Beyond this angle, incident light will be reflected primarily skywards. This is because the angle of reflection of light from a point source will always be the same as the angle of incidence.

Aviation Guidance (CAA)

The UK Civil Aviation Authority (CAA) issued interim guidance in relation to solar farms in December 2010[6]. The formal policy was cancelled in September 2012, however in the absence of formal policy, the guidance is still relevant. It refers to solar farms as Solar Photovoltaic Systems (SPV).

CAA Interim Guidance

This interim guidance makes the following recommendations (p.2-3):

"8. It is recommended that, as part of a planning application, the SPV developer provide safety assurance documentation (including risk assessment) regarding the full potential impact of the SPV installation on aviation interests.

9. Guidance on safeguarding procedures at CAA licensed aerodromes is published within CAP 738 Safeguarding of Aerodromes and advice for unlicensed aerodromes is contained within CAP 793 Safe Operating Practices at Unlicensed Aerodromes.

10. Where proposed developments in the vicinity of aerodromes require an application for planning permission the relevant LPA normally consults aerodrome operators or NATS when aeronautical interests might be affected. This consultation procedure is a statutory obligation in the case of certain major airports, and may include military establishments and certain air traffic surveillance technical sites. These arrangements are explained in Department for Transport Circular 1/2003 and for Scotland, Scottish Government Circular 2/2003.

11. In the event of SPV developments proposed under the Electricity Act, the relevant government department should routinely consult with the CAA. There is therefore no

[6] Civil Aviation Authority, 2010. "*Interim CAA Guidance - Solar Photovoltaic Systems*"

requirement for the CAA to be separately consulted for such proposed SPV installations or developments.

12. If an installation of SPV systems is planned on-aerodrome (i.e. within its licensed boundary) then it is recommended that data on the reflectivity of the solar panel material should be included in any assessment before installation approval can be granted. Although approval for installation is the responsibility of the ALH10, as part of a condition of a CAA Aerodrome Licence, the ALH is required to obtain prior consent from CAA Aerodrome Standards Department before any work is begun or approval to the developer or LPA is granted, in accordance with the procedures set out in CAP 791 Procedures for Changes to Aerodrome Infrastructure.

13. During the installation and associated construction of SPV systems there may also be a need to liaise with nearby aerodromes if cranes are to be used; CAA notification and permission is not required.

14. The CAA aims to replace this informal guidance with formal policy in due course and reserves the right to cancel, amend or alter the guidance provided in this document at its discretion upon receipt of new information.

15. Further guidance may be obtained from CAA's Aerodrome Standards Department via aerodromes@caa.co.uk."

The CAA Civil Aviation Publication (CAP) 738 document[7] notes:

"In 2010 the CAA published interim guidance on Solar Photovoltaic Cells (SPCs). At that time, it was agreed that we would review our policy based on research carried out by the Federal Aviation Authorities (FAA) in the United States, in addition to reviewing guidance issued by other National Aviation Authorities. New information and field experience, particularly with respect to compatibility and glare, has resulted in the FAA reviewing its original document 'Technical Guidance for Evaluating Selected Solar Technologies on Airports', which is likely to be subject to change, see link;

https://www.federalregister.gov/documents/2013/10/23/2013-24729/interimpolicy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports

[7] Civil Aviation Authority - Safety and Airspace Regulation Group, 2020, CAP 738, "*Safeguarding of Aerodromes*".

In the United Kingdom there has been a further increase in SPV cells, including some located close to aerodrome boundaries; to date the CAA has not received any detrimental comments or issues of glare at these established sites. Whilst this early indication is encouraging, those responsible for safeguarding should remain vigilant to the possibility."

Renewable energy developments: solar photovoltaic developments CAST Aerodrome Safeguarding Guidance Note[8].

As of July 2023, Industry body, The Combined Aerodrome Safeguarding Team (CAST), has released its guidance document titled 'Renewable energy developments: solar photovoltaic developments CAST Aerodrome Safeguarding Guidance Note'.

With regard to glint, it suggests that the developer should supply:

"... a glint and glare survey when a development is within a distance specified by the aerodrome from an Aerodrome Reference Point (ARP) (5km in most cases)".

The document also states that:

"For many aerodromes, 5km is the distance of choice but it could be considered out to 10km. In exceptional circumstances, assessments may be required beyond 10km."

The document provides some considerations on safety and states:

"Safety considerations must be assessed for the design of the planned solar photovoltaic development for Air Traffic Services (ATS) personnel, pilots and for CNS equipment:

- *ATS personnel – The control tower (if applicable) is the most important location for visual surveillance across an aerodrome for monitoring operations on the ground as well as in the air. It is therefore of critical importance that the development of solar photovoltaic developments does not significantly hinder the view from a control tower's visual control room (VCR). This may be from redesigning the layout and design of the proposed solar development to avoid glare from the solar panels or by avoiding the physical blocking of key viewpoints.*
- *Pilot – A pilot's ability to safely navigate the airspace around an aerodrome is paramount. A pilot is required to look for other aircraft and obstructions on the ground, as well as navigate towards a runway or reference points. This applies to both pilots of*

[8] Combined Aerodrome Safeguarding Team (CAST), 2023, "Renewable energy developments: solar photovoltaic developments CAST Aerodrome Safeguarding Guidance Note" Available at: cast-renewable-energy-developments-solar-july-2023.pdf (caa.co.uk)

fixed wing aircraft and helicopters in the air, and sometimes on the ground. The standard operations that should be considered are:

- *pilots on approach*
- *pilots in a visual circuit*
- *pilots on the ground (departing and taxiing aircraft)."*

The document also makes note of other available guidance:

"The UK CAA and US FAA have produced guidance with respect to glint and glare however neither of them mandates a specific methodology for assessing the effects of glint and glare. The effects of glare may mean that some solar PV developments are unacceptable, however layout modifications (such as changes to panel tilt and elevation angle) can often alleviate these concerns and overcome objections. The benefit of early consultation with the aerodrome authority cannot be understated."

The document comments on the Aerodrome Operator's Safety Assurance stating:

"The aerodrome operator in conjunction with any ATS personnel should, as part of the change management process in their safety management system, consider all the potential hazards posed by solar photovoltaic developments… The developer should provide the aerodrome with a safety survey which should include:

- *a glint and glare survey when a development is within a distance specified by the aerodrome from an Aerodrome Reference Point (ARP) (5km in most cases)*

The aerodrome operator should also ensure both impact and safety assessments are undertaken to provide assurance that any on- or off-aerodrome planned development does not introduce unacceptable hazards to aircrew, ATS personnel, RFFS and aerodrome vehicle operators undertaking their tasks.

As part of the aerodrome and or ATS change management process, safety assurances should take into account any potential adverse effect to critical ATS infrastructure and equipment.

The assessment must also consider any impacts to aircraft utilising instrument flight procedures and aircraft in the visual circuit.

Developers should apply the same principals for safety assurance for unlicensed aerodromes and airfields as required by this policy that are not officially safeguarded.

The developer in conjunction with the aerodrome operator, ATS personnel, RFFS and aerodrome operations should develop adequate mitigation to mitigate any risks identified.

Should risk mitigation or agreement not be possible, the aerodrome operator should follow Local Planning Authority procedures and lodge an objection regarding the development under their statutory obligations."

Aviation Guidance (FAA)

The most comprehensive guidance setting out a methodology for assessing solar farm developments near aerodromes was produced November 2010 by the US Federal Aviation Administration (FAA) in a document entitled '*Technical Guidance for Evaluating Selected Solar Technologies on Airports*'. This was updated in Oct 2013 in the '*Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports*'. In April 2018 the FAA released a new version (Version 1.1) of the '*Technical Guidance for Evaluating Selected Solar Technologies on Airports*', and in May 2021 it provided a further set of guidance entitled '*14CRF Part 77 - FAA Policy: Review of Solar Energy System Projects on Federally Obligated Airports*'.

In this last review the FAA concluded, contrary to its initial beliefs, that:

"...in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should be focused on the impact of on airport solar energy systems to federally obligated towered airports, specifically the airport's ATCT cab."

Operational Examples

There are a considerable number of large-scale solar installations that are already operating and located near to airports overseas. These include Newquay Airport in Cornwall, UK and Dunsfold Aerodrome in Surrey, also in the UK. Figure 1 shows a large-scale solar farm similar to the proposed scheme constructed at Dusseldorf Airport, glint from the solar farm has not affected flight operations.

Figure 1: Solar Farm Adjacent to the Runway at Dusseldorf Airport (Aviation Pros, 2013[9])

A ground-mounted array of panels has also been installed at London Gatwick on land adjacent to the runway and taxiway (see Figure 2). Consultation was undertaken between the developer and the Gatwick aerodrome safeguarding team, National Air Traffic Services (NATS), and NATS (En Route) Plc (NERL) (Crawley Borough Council, Planning Ref: CR/2011/0602/CON). These consultees did not object to the proposal on any grounds including glint.

[9] Aviation Pros, 2013. 'Düsseldorf International Airport Goes Solar' [Online] Available at: http://www.aviationpros.com/news/10599152/dsseldorf-international-airport-goes-solar [Accessed 23 July 2022]

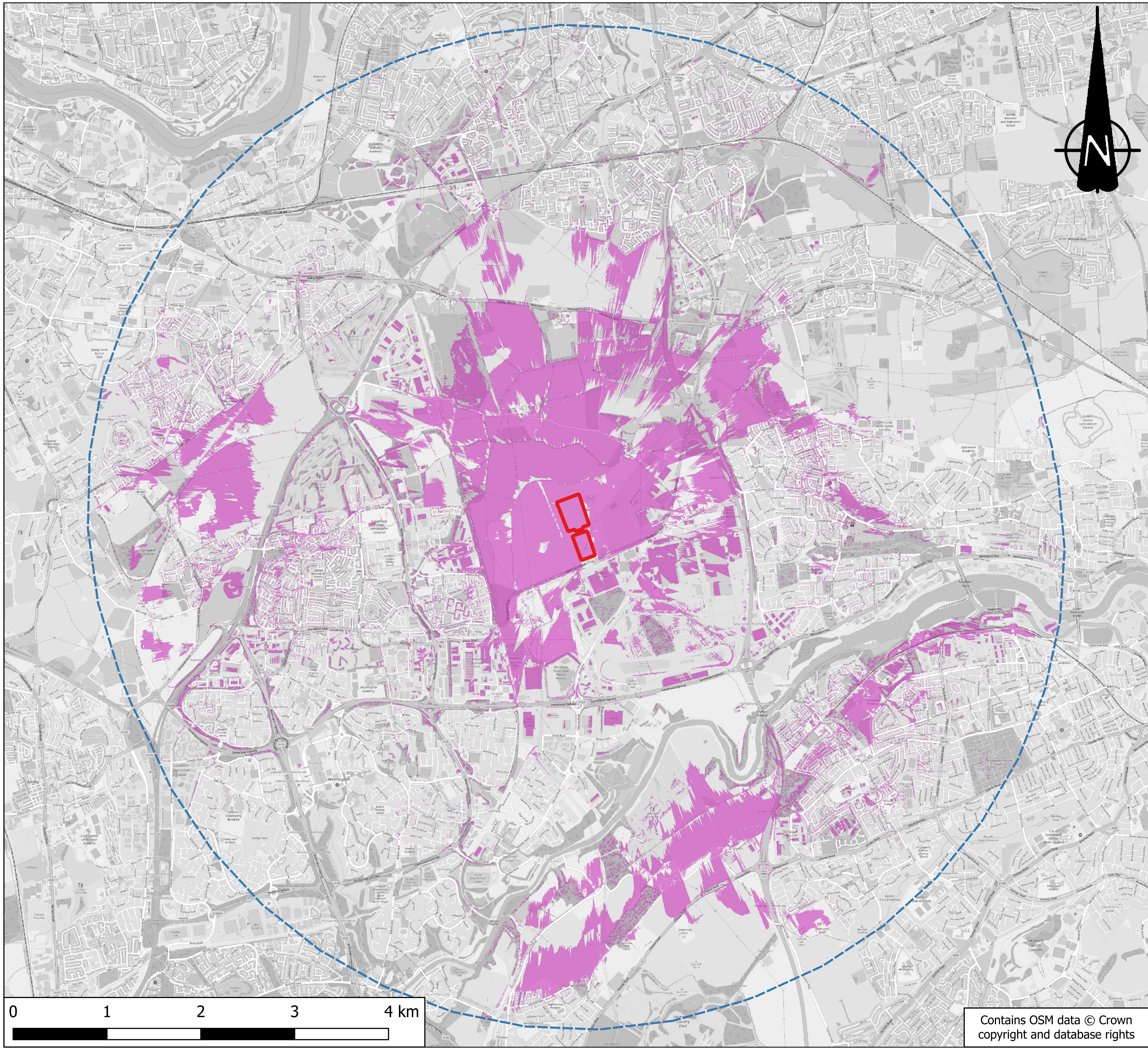
Figure 2: Solar Array next to Gatwick Runway (Business Green, 2013[10])

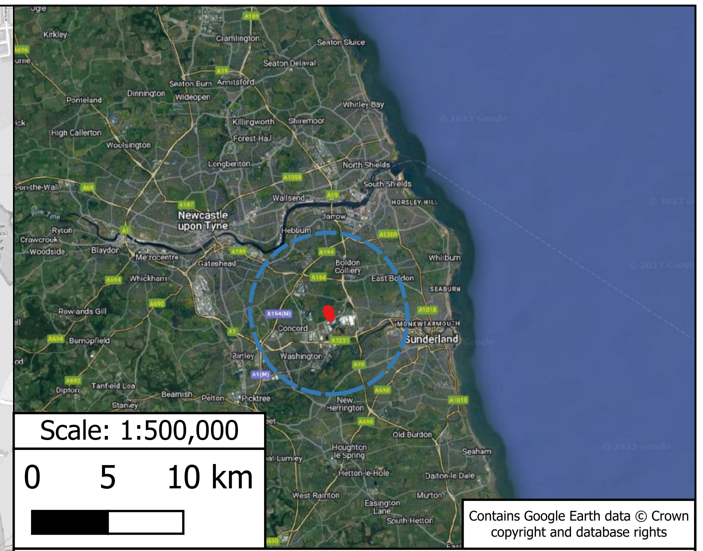
It is not expected that the potential for glint generated by the proposed solar farm could cause any serious operational effects to aircraft but since the position of the sun in the sky and the angle of the panels will be known, it is possible to predict exactly when there would be any chance of affecting a particular flight path and hence it would be possible to forewarn any pilots.

[10] Business Green, 2013. 'Gatwick solar system hailed a runway success'. [Online] Available at: http://www.businessgreen.com/bg/news/2156392/gatwick-solar-cleared [Accessed 23 July 2022]

Appendix 3.1.2

Zone of Theoretical Visibility





Notes: Panels have been modelled to represent their locations on top of the development and an observer height of 1.8m has been used to generate the ZTV. The ZTV uses 2m LiDAR data provided by the Environment Agency. This accounts for intervening topography and surface screening from buildings and trees.

Legend

- Site boundary
- 5km buffer
- ZTV

CLIENT AESC		
PROJECT IAMP - Gigawatt Factory		
DRAWING TITLE Zone of Theoretical Visibility		
DRG No. 001		REV: A
DRG SIZE: A3	SCALE: 1:40000	DATE: October 2023
DRAWN: JS	CHECKED BY: SA	APPROVED BY: SA

wardell armstrong

Appendix 3.1.3

ForgeSolar Report

FORGESOLAR GLARE ANALYSIS

Project: **IAMP Sunderland rooftop**
Site configuration: **NT15821 Giga 3**

Created 11 Sep, 2023
Updated 03 Oct, 2023
Time-step 1 minute
Timezone offset UTC0
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 1 MW to 5 MW
Site ID 101165.9902

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PVA east H	1.0	67.0	9,004	150.1	0	0.0	-	64,094
PVA east L	4.0	67.0	18,618	310.3	0	0.0	-	125,609
PVA west H	1.0	247.0	2,625	43.8	0	0.0	-	32,817
PVA west L	4.0	267.0	2,493	41.5	0	0.0	-	46,227
PVB east H	1.0	67.0	6,135	102.2	0	0.0	-	38,277
PVB east L	4.0	67.0	23,381	389.7	0	0.0	-	163,263
PVB west H	1.0	267.0	2,293	38.2	0	0.0	-	37,473
PVB west L	4.0	267.0	3,064	51.1	0	0.0	-	61,880
PVC east H	1.0	67.0	15,754	262.6	0	0.0	-	180,645
PVC east L	5.0	67.0	39,314	655.2	659	11.0	-	307,616
PVC west H	1.0	247.0	1,752	29.2	0	0.0	-	64,228
PVC west L	5.0	247.0	3,206	53.4	0	0.0	-	48,470
PVD east H	1.0	67.0	14,445	240.8	0	0.0	-	139,963
PVD east L	5.0	67.0	37,511	625.2	0	0.0	-	244,791
PVD west H	1.0	267.0	7,075	117.9	0	0.0	-	46,555
PVD west L	5.0	247.0	3,680	61.3	0	0.0	-	60,419
PW east H	1.0	67.0	14,762	246.0	0	0.0	-	243,356
PW east L	5.0	67.0	36,076	601.3	3,395	56.6	-	868,955
PW west H	1.0	247.0	5,389	89.8	984	16.4	-	424,100
PW west L	5.0	247.0	5,388	89.8	52	0.9	-	308,166

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Route 1	49,794	829.9	5,090	84.8
Route 2	34,104	568.4	0	0.0
Route 3	57,791	963.2	0	0.0
Route 4	19,040	317.3	0	0.0
Route 5	17,420	290.3	0	0.0
FP 1	0	0.0	0	0.0
FP 2	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	8,660	144.3	0	0.0
OP 3	8,920	148.7	0	0.0
OP 4	9,707	161.8	0	0.0
OP 5	0	0.0	0	0.0
OP 6	13,879	231.3	0	0.0
OP 7	9,214	153.6	0	0.0
OP 8	0	0.0	0	0.0
OP 9	8,272	137.9	0	0.0
OP 10	0	0.0	0	0.0
OP 11	15,164	252.7	0	0.0

Component Data

PV Arrays

Name: PVA east H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.924954	-1.491400	37.83	26.00	63.83
2	54.923707	-1.490407	39.41	26.00	65.41
3	54.923813	-1.489994	39.44	24.56	64.00
4	54.925058	-1.490981	37.65	24.56	62.21

Name: PVA east L
Axis tracking: Fixed (no rotation)
Tilt: 4.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.923813	-1.489995	39.45	24.56	64.01
2	54.925058	-1.490981	37.65	24.56	62.21
3	54.925162	-1.490589	37.53	23.50	61.03
4	54.923908	-1.489608	39.23	23.50	62.73

Name: PVA west H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 247.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.923602	-1.490829	38.94	24.56	63.50
2	54.924849	-1.491804	38.27	24.56	62.83
3	54.924954	-1.491400	37.83	26.00	63.83
4	54.923707	-1.490409	39.41	26.00	65.41

Name: PVA west L
Axis tracking: Fixed (no rotation)
Tilt: 4.0°
Orientation: 267.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.924754	-1.492197	38.71	23.50	62.21
2	54.923499	-1.491247	39.03	23.50	62.53
3	54.923602	-1.490829	38.94	24.56	63.50
4	54.924848	-1.491804	38.27	24.56	62.83

Name: PVB east H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.924116	-1.488777	38.43	33.00	71.43
2	54.925369	-1.489763	37.66	33.00	70.66
3	54.925480	-1.489343	37.74	31.96	69.70
4	54.924225	-1.488366	38.22	31.96	70.18

Name: PVB east L
Axis tracking: Fixed (no rotation)
Tilt: 4.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.924225	-1.488367	38.20	31.96	70.16
2	54.925480	-1.489343	37.74	31.96	69.70
3	54.925593	-1.488909	37.31	30.50	67.81
4	54.924338	-1.487928	37.50	30.50	68.00

Name: PVB west H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 267.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.924016	-1.489185	38.96	31.96	70.92
2	54.925269	-1.490179	36.90	31.96	68.86
3	54.925368	-1.489763	37.66	33.00	70.66
4	54.924116	-1.488775	38.42	33.00	71.42

Name: PVB west L
Axis tracking: Fixed (no rotation)
Tilt: 4.0°
Orientation: 267.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.923908	-1.489609	39.23	30.50	69.73
2	54.925162	-1.490590	37.53	30.50	68.03
3	54.925268	-1.490178	36.90	31.96	68.86
4	54.924016	-1.489185	38.96	31.96	70.92

Name: PVC east H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.922253	-1.489287	38.46	18.00	56.46
2	54.923706	-1.490408	39.41	18.00	57.41
3	54.923814	-1.489995	39.45	16.51	55.96
4	54.922064	-1.488627	39.06	16.51	55.57
5	54.922043	-1.488708	38.87	17.00	55.87
6	54.922027	-1.488765	38.67	0.00	38.67
7	54.922018	-1.488797	38.55	17.00	55.55
8	54.922016	-1.488808	38.52	17.00	55.52
9	54.922009	-1.488836	38.48	17.00	55.48
10	54.922055	-1.488864	38.45	17.00	55.45
11	54.922309	-1.489073	38.47	17.00	55.47
12	54.922309	-1.489073	38.47	17.00	55.47
13	54.922309	-1.489073	38.47	17.00	55.47
14	54.922309	-1.489073	38.47	17.00	55.47
15	54.922309	-1.489073	38.47	0.00	38.47
16	54.922309	-1.489073	38.47	17.00	55.47

Name: PVC east L
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.922064	-1.488628	39.06	16.51	55.57
2	54.923814	-1.489995	39.45	16.51	55.96
3	54.923908	-1.489609	39.23	15.00	54.23
4	54.922156	-1.488220	38.83	15.00	53.83

Name: PVC west H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 247.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.922141	-1.489720	38.76	16.50	55.26
2	54.923601	-1.490830	38.94	16.50	55.44
3	54.923706	-1.490408	39.41	18.00	57.41
4	54.922253	-1.489289	38.46	18.00	56.46

Name: PVC west L
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 247.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.922040	-1.490146	38.69	15.00	53.69
2	54.923499	-1.491249	39.03	15.00	54.03
3	54.923602	-1.490830	38.94	16.51	55.45
4	54.922140	-1.489719	38.76	16.51	55.27

Name: PVD east H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.922664	-1.487674	38.82	18.00	56.82
2	54.924116	-1.488777	38.43	18.00	56.43
3	54.924225	-1.488366	38.20	16.51	54.71
4	54.922774	-1.487248	38.76	16.51	55.27

Name: PVD east L
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.922774	-1.487249	38.76	16.51	55.27
2	54.924225	-1.488366	38.20	16.51	54.71
3	54.924338	-1.487927	37.50	15.00	52.50
4	54.922878	-1.486834	38.85	15.00	53.85

Name: PVD west H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 267.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.922254	-1.487845	39.08	16.51	55.59
2	54.924017	-1.489185	38.96	16.51	55.47
3	54.924115	-1.488775	38.44	18.00	56.44
4	54.922664	-1.487675	38.82	18.00	56.82
5	54.922611	-1.487855	38.81	17.00	55.81
6	54.922609	-1.487878	38.79	0.00	38.79
7	54.922580	-1.487853	38.81	17.00	55.81
8	54.922553	-1.487830	38.83	17.00	55.83
9	54.922534	-1.487815	38.86	17.00	55.86
10	54.922519	-1.487803	38.89	17.00	55.89
11	54.922320	-1.487653	39.23	17.00	56.23
12	54.922303	-1.487636	39.25	17.00	56.25
13	54.922299	-1.487651	39.24	17.00	56.24
14	54.922291	-1.487684	39.21	17.00	56.21
15	54.922286	-1.487705	39.20	0.00	39.20
16	54.922279	-1.487739	39.16	17.00	56.16

Name: PVD west L
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 247.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.922157	-1.488219	38.83	15.00	53.83
2	54.923908	-1.489608	39.23	15.00	54.23
3	54.924016	-1.489184	38.96	16.51	55.47
4	54.922254	-1.487844	39.08	16.51	55.59

Name: PW east H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.921848	-1.488160	39.16	18.00	57.16
2	54.919747	-1.486548	38.24	18.00	56.24
3	54.919870	-1.486017	38.46	16.00	54.46
4	54.921951	-1.487605	39.65	16.00	55.65

Name: PW east L
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 67.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.921968	-1.487626	39.63	16.00	55.63
2	54.919872	-1.486039	38.47	16.00	54.47
3	54.920030	-1.485470	38.43	14.00	52.43
4	54.922136	-1.487097	39.81	14.00	53.81

Name: PW west H
Axis tracking: Fixed (no rotation)
Tilt: 1.0°
Orientation: 247.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

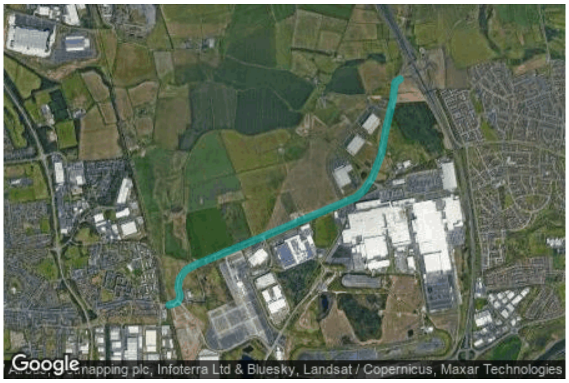
Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.921719	-1.488703	38.73	16.00	54.73
2	54.919606	-1.487086	38.34	16.00	54.34
3	54.919743	-1.486550	38.24	18.00	56.24
4	54.921847	-1.488161	39.16	18.00	57.16

Name: PW west L
Axis tracking: Fixed (no rotation)
Tilt: 5.0°
Orientation: 247.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.919469	-1.487615	41.00	14.00	55.00
2	54.921579	-1.489242	41.03	14.00	55.03
3	54.921719	-1.488703	40.15	16.00	56.15
4	54.919606	-1.487086	41.00	16.00	57.00

Route Receptors

Name: Route 1
Path type: Two-way
Observer view angle: 50.0°



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.913303	-1.502017	46.40	1.00	47.40
2	54.913501	-1.500837	45.84	1.00	46.84
3	54.914019	-1.500472	44.68	1.00	45.68
4	54.914623	-1.500794	42.97	1.00	43.97
5	54.915351	-1.500601	41.96	1.00	42.96
6	54.916042	-1.499764	41.65	1.00	42.65
7	54.916510	-1.498262	42.49	1.00	43.49
8	54.918742	-1.488907	40.06	1.00	41.06
9	54.921801	-1.476311	37.59	1.00	38.59
10	54.922368	-1.475238	36.95	1.00	37.95
11	54.923355	-1.474079	34.55	1.00	35.55
12	54.925204	-1.472835	36.48	1.00	37.48
13	54.927226	-1.472191	37.53	1.00	38.53
14	54.929347	-1.471290	36.74	1.00	37.74
15	54.930876	-1.470947	38.09	1.00	39.09
16	54.931122	-1.470260	37.65	1.00	38.65

Name: Route 2
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.921628	-1.478199	37.67	1.00	38.67
2	54.923379	-1.479701	36.53	1.00	37.53
3	54.924242	-1.480173	36.65	1.00	37.65
4	54.925278	-1.479734	34.52	1.00	35.52
5	54.926265	-1.478242	36.21	1.00	37.21
6	54.929171	-1.474106	34.53	1.00	35.53
7	54.928918	-1.473538	35.14	1.00	36.14
8	54.928739	-1.472771	35.19	1.00	36.19
9	54.928631	-1.471923	35.86	1.00	36.86
10	54.928619	-1.471779	36.50	1.00	37.50

Name: Route 3
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.934916	-1.509621	46.84	1.00	47.84
2	54.934744	-1.509299	46.68	1.00	47.68
3	54.934349	-1.509063	47.05	1.00	48.05
4	54.934177	-1.508612	46.17	1.00	47.17
5	54.933930	-1.506466	45.84	1.00	46.84
6	54.933498	-1.504535	43.33	1.00	44.33
7	54.933375	-1.503613	43.69	1.00	44.69
8	54.933363	-1.501402	45.09	1.00	46.09
9	54.933437	-1.500651	46.62	1.00	47.62
10	54.933449	-1.499621	47.63	1.00	48.63
11	54.933240	-1.498355	46.43	1.00	47.43
12	54.933178	-1.497218	44.15	1.00	45.15
13	54.932919	-1.494708	38.58	1.00	39.58
14	54.932956	-1.493957	41.15	1.00	42.15
15	54.932623	-1.492755	41.69	1.00	42.69
16	54.932278	-1.491446	39.86	1.00	40.86
17	54.932118	-1.489257	38.85	1.00	39.85
18	54.931957	-1.488592	38.92	1.00	39.92
19	54.931760	-1.485352	38.54	1.00	39.54
20	54.931205	-1.483335	37.99	1.00	38.99
21	54.930823	-1.482155	37.46	1.00	38.46
22	54.930355	-1.480953	36.27	1.00	37.27
23	54.930108	-1.480782	35.68	1.00	36.68
24	54.929615	-1.480760	36.58	1.00	37.58
25	54.929529	-1.480395	36.53	1.00	37.53
26	54.929923	-1.479880	37.63	1.00	38.63
27	54.929899	-1.478250	37.60	1.00	38.60
28	54.929763	-1.476790	38.89	1.00	39.89
29	54.929948	-1.474816	36.40	1.00	37.40
30	54.930971	-1.471641	37.68	1.00	38.68

Name: Route 4
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.949540	-1.473772	31.16	1.00	32.16
2	54.946472	-1.473451	33.73	1.00	34.73
3	54.940802	-1.474024	35.54	1.00	36.54
4	54.938842	-1.473638	36.92	1.00	37.92
5	54.935033	-1.470934	35.52	1.00	36.52
6	54.928663	-1.465071	33.25	1.00	34.25
7	54.926561	-1.463358	31.27	1.00	32.27
8	54.923909	-1.461770	32.57	1.00	33.57
9	54.920987	-1.460654	32.06	1.00	33.06
10	54.918804	-1.460139	30.93	1.00	31.93
11	54.917127	-1.460032	30.72	1.00	31.72
12	54.914576	-1.460186	32.48	1.00	33.48
13	54.910764	-1.460959	31.90	1.00	32.90
14	54.908224	-1.460894	29.61	1.00	30.61
15	54.906251	-1.459778	29.12	1.00	30.12
16	54.903882	-1.457847	7.14	1.00	8.14
17	54.901563	-1.456216	40.19	1.00	41.19
18	54.899638	-1.455401	43.60	1.00	44.60
19	54.897713	-1.455358	59.39	1.00	60.39
20	54.895911	-1.456345	66.94	1.00	67.94
21	54.894357	-1.457075	73.72	1.00	74.72
22	54.891967	-1.458080	82.35	1.00	83.35
23	54.890647	-1.458381	88.23	1.00	89.23

Name: Route 5
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	54.904047	-1.448076	39.31	2.75	42.06
2	54.905020	-1.446381	38.19	2.75	40.94
3	54.905329	-1.445828	39.27	2.75	42.02
4	54.905752	-1.445069	39.03	2.75	41.78
5	54.906739	-1.443374	40.09	2.75	42.84
6	54.907106	-1.442709	40.53	2.75	43.28
7	54.907720	-1.441619	41.67	2.75	44.42
8	54.908509	-1.440085	43.64	2.75	46.39
9	54.909274	-1.438336	44.37	2.75	47.12
10	54.909971	-1.436453	44.06	2.75	46.81
11	54.910942	-1.433165	42.90	2.75	45.65
12	54.911618	-1.430461	37.73	2.75	40.48
13	54.911914	-1.428948	39.89	2.75	42.64
14	54.912093	-1.427731	37.46	2.75	40.21
15	54.912420	-1.423144	34.15	2.75	36.90

Flight Path Receptors

Name: FP 1
Description:
Threshold height: 15 m
Direction: 245.2°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	55.042314	-1.673254	72.97	15.24	88.21
Two-mile	55.054465	-1.627412	58.63	198.26	256.90

Name: FP 2
Description:
Threshold height: 15 m
Direction: 65.1°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	55.034000	-1.704644	78.65	15.24	93.89
Two-mile	55.021831	-1.750462	127.72	134.86	262.58

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	54.918646	-1.485526	38.99	1.80
OP 2	2	54.924194	-1.478735	35.89	1.80
OP 3	3	54.920544	-1.477576	38.32	1.80
OP 4	4	54.926183	-1.476951	36.09	1.80
OP 5	5	54.915509	-1.489109	41.01	1.80
OP 6	6	54.905941	-1.439009	61.36	1.80
OP 7	7	54.910460	-1.429750	47.45	1.80
OP 8	8	54.878360	-1.495908	57.29	1.00
OP 9	9	54.933912	-1.513892	50.98	1.80
OP 10	10	54.948902	-1.481008	33.69	1.80
OP 11	11	54.941986	-1.460059	36.75	1.00

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m²
PVA east H	1.0	67.0	9,004	150.1	0	0.0	-	64,094
PVA east L	4.0	67.0	18,618	310.3	0	0.0	-	125,609
PVA west H	1.0	247.0	2,625	43.8	0	0.0	-	32,817
PVA west L	4.0	267.0	2,493	41.5	0	0.0	-	46,227
PVB east H	1.0	67.0	6,135	102.2	0	0.0	-	38,277
PVB east L	4.0	67.0	23,381	389.7	0	0.0	-	163,263
PVB west H	1.0	267.0	2,293	38.2	0	0.0	-	37,473
PVB west L	4.0	267.0	3,064	51.1	0	0.0	-	61,880
PVC east H	1.0	67.0	15,754	262.6	0	0.0	-	180,645
PVC east L	5.0	67.0	39,314	655.2	659	11.0	-	307,616
PVC west H	1.0	247.0	1,752	29.2	0	0.0	-	64,228
PVC west L	5.0	247.0	3,206	53.4	0	0.0	-	48,470
PVD east H	1.0	67.0	14,445	240.8	0	0.0	-	139,963
PVD east L	5.0	67.0	37,511	625.2	0	0.0	-	244,791
PVD west H	1.0	267.0	7,075	117.9	0	0.0	-	46,555
PVD west L	5.0	247.0	3,680	61.3	0	0.0	-	60,419
PW east H	1.0	67.0	14,762	246.0	0	0.0	-	243,356
PW east L	5.0	67.0	36,076	601.3	3,395	56.6	-	868,955
PW west H	1.0	247.0	5,389	89.8	984	16.4	-	424,100
PW west L	5.0	247.0	5,388	89.8	52	0.9	-	308,166

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

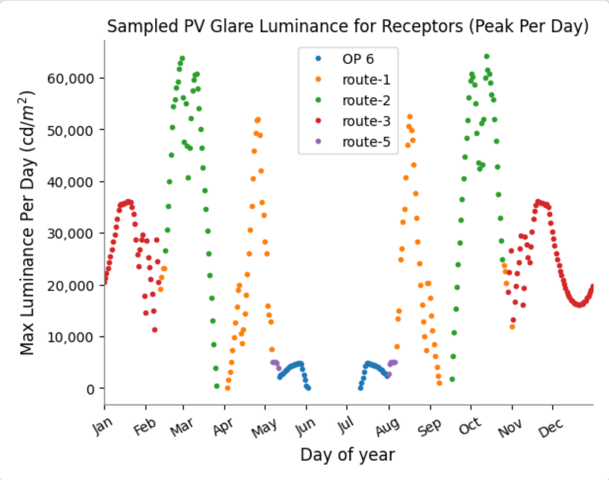
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Route 1	49,794	829.9	5,090	84.8
Route 2	34,104	568.4	0	0.0
Route 3	57,791	963.2	0	0.0
Route 4	19,040	317.3	0	0.0
Route 5	17,420	290.3	0	0.0
FP 1	0	0.0	0	0.0
FP 2	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	8,660	144.3	0	0.0
OP 3	8,920	148.7	0	0.0
OP 4	9,707	161.8	0	0.0
OP 5	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 6	13,879	231.3	0	0.0
OP 7	9,214	153.6	0	0.0
OP 8	0	0.0	0	0.0
OP 9	8,272	137.9	0	0.0
OP 10	0	0.0	0	0.0
OP 11	15,164	252.7	0	0.0

PV: PVA east H low potential for temporary after-image

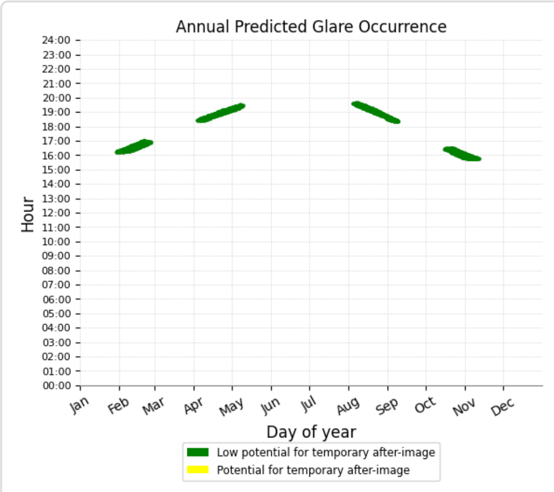
Receptor results ordered by category of glare

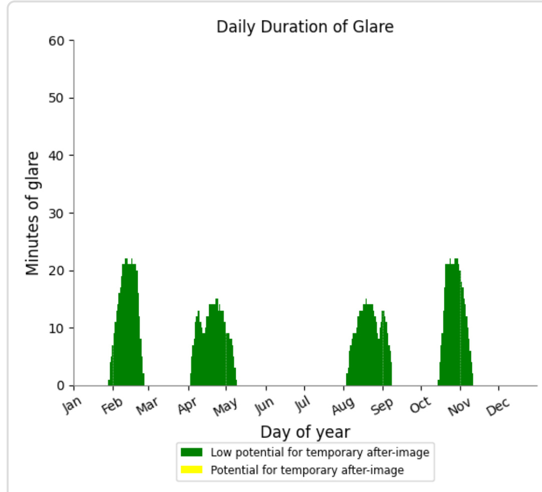
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m²
Route 1	1,581	26.4	0	0.0	52,593
Route 2	1,468	24.5	0	0.0	64,094
Route 3	2,335	38.9	0	0.0	36,113
Route 5	967	16.1	0	0.0	5,090
Route 4	0	0.0	0	0.0	0
FP 1	0	0.0	0	0.0	0
FP 2	0	0.0	0	0.0	0
OP 6	776	12.9	0	0.0	4,846
OP 7	526	8.8	0	0.0	4,110
OP 11	1,351	22.5	0	0.0	9,259
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0

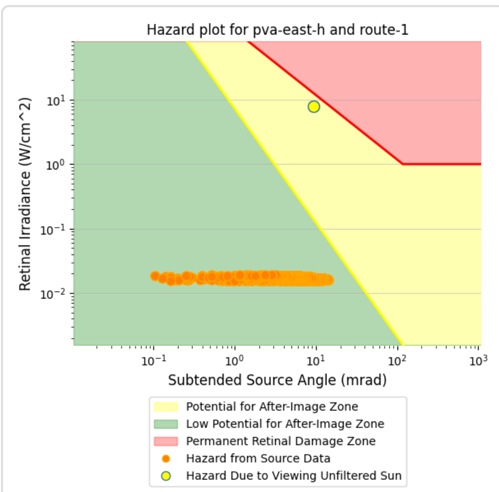


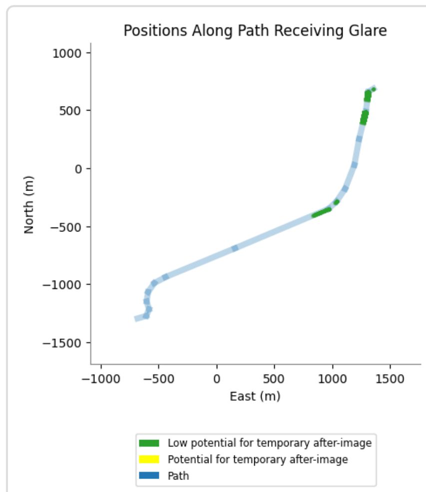
PVA east H and Route: Route 1

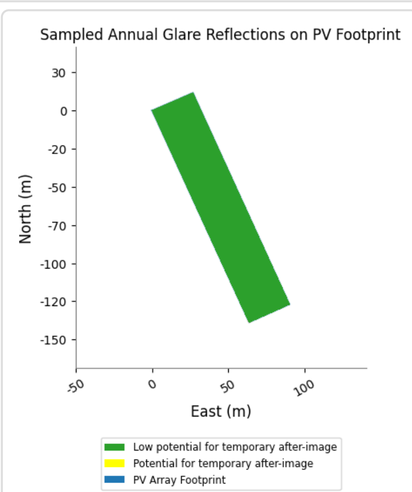
Yellow glare: none
Green glare: 1,581 min.

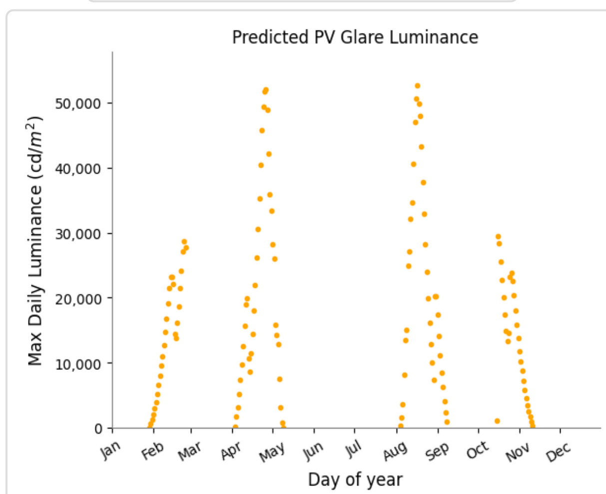








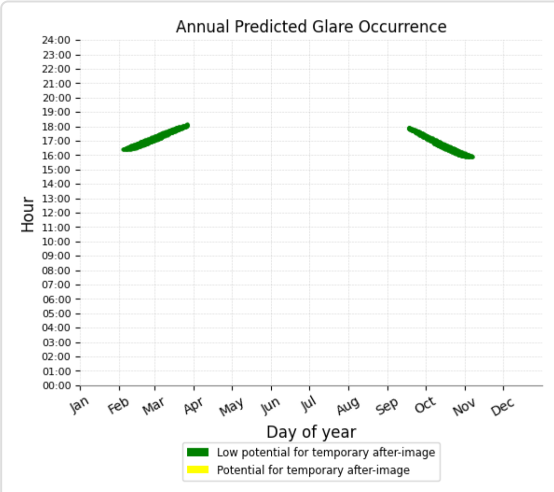


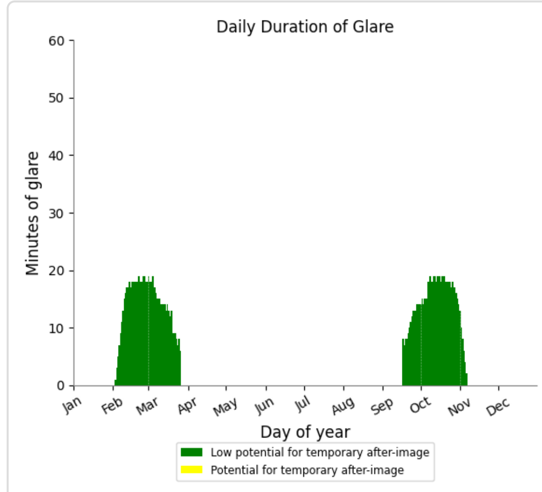


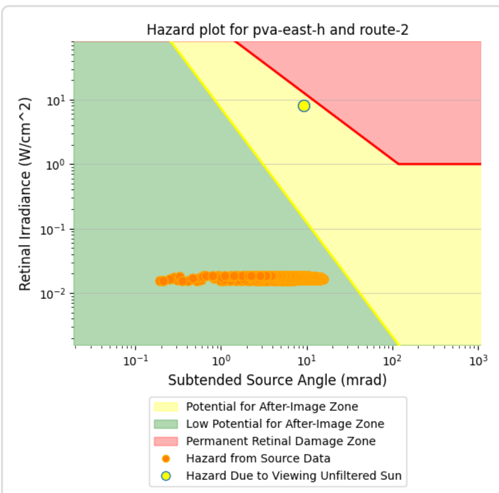
PVA east H and Route: Route 2

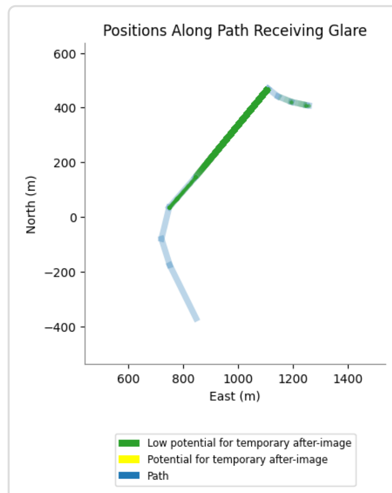
Yellow glare: none

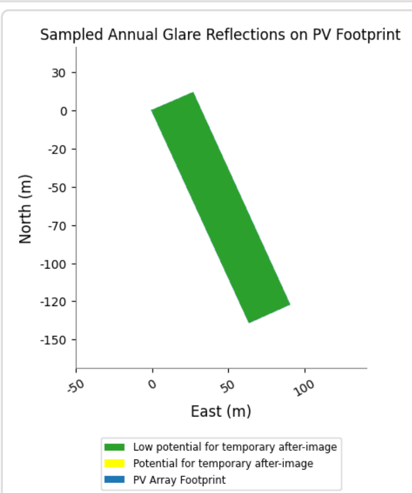
Green glare: 1,468 min.

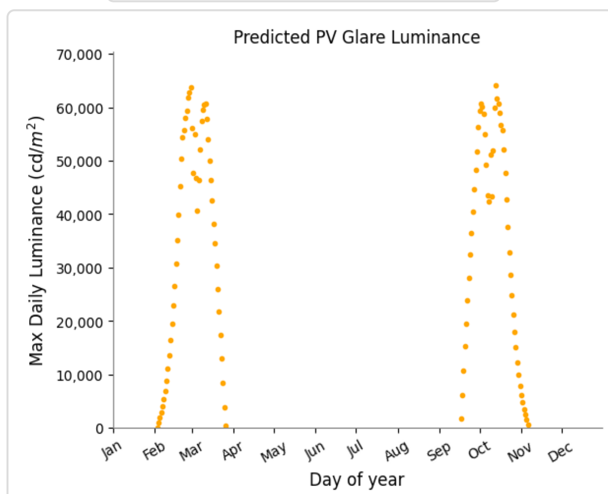








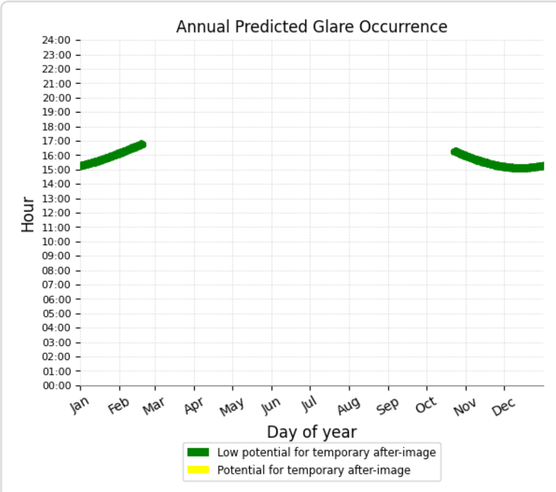


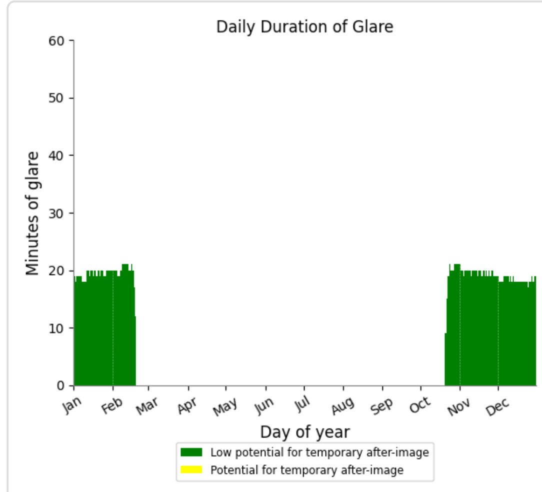


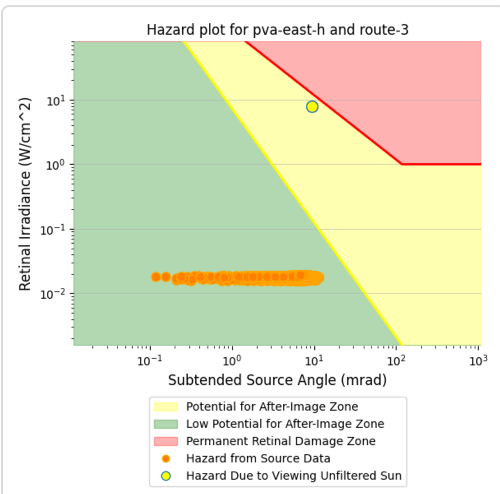
PVA east H and Route: Route 3

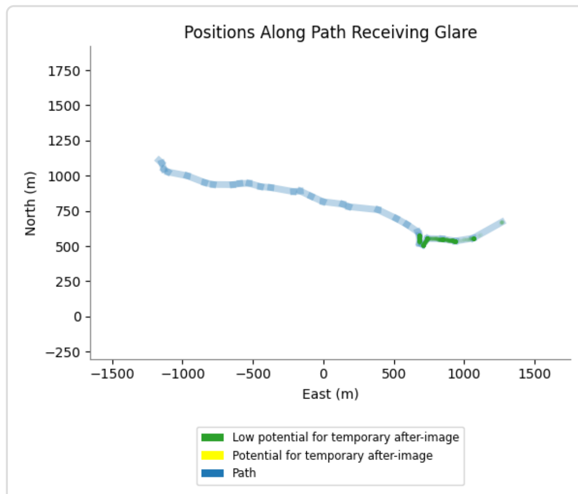
Yellow glare: none

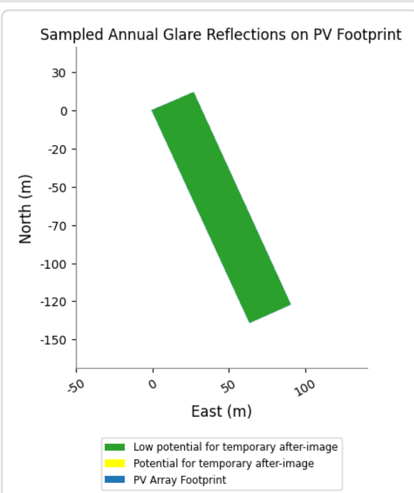
Green glare: 2,335 min.

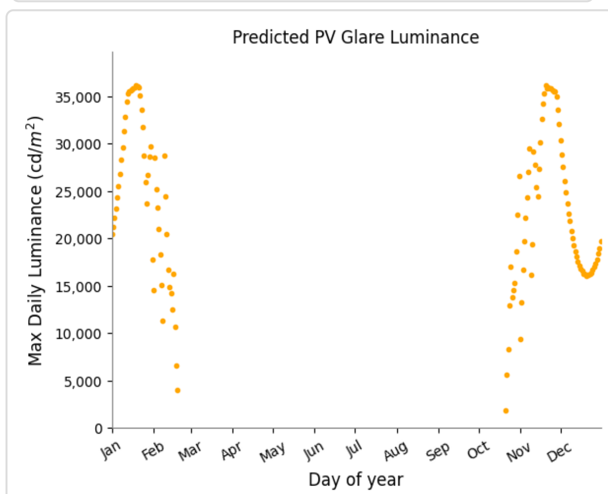








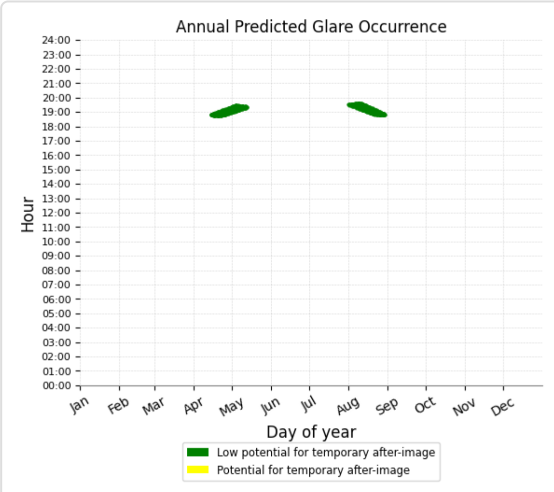


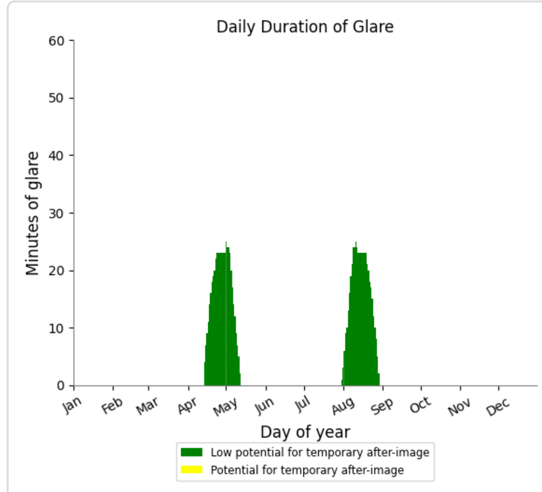


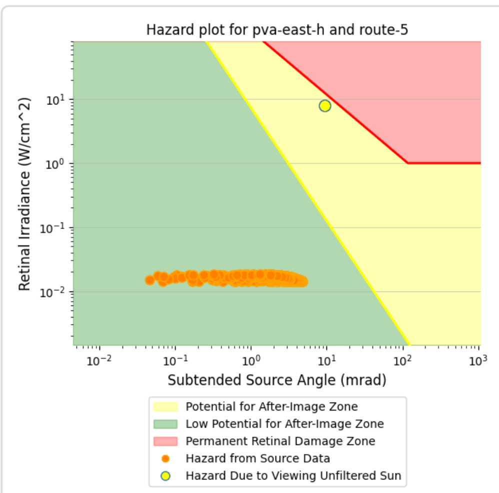
PVA east H and Route: Route 5

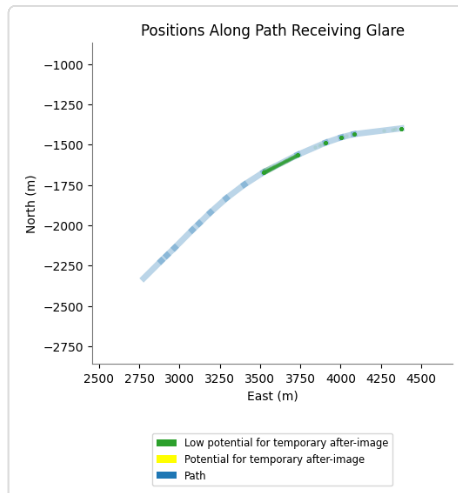
Yellow glare: none

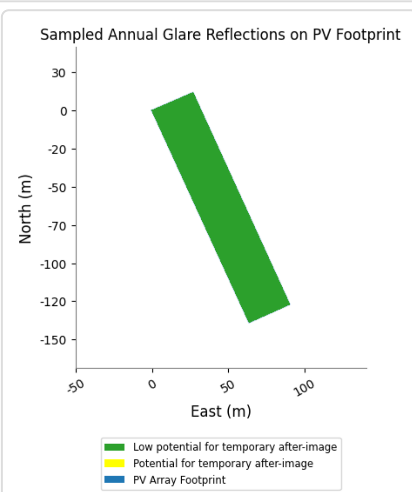
Green glare: 967 min.

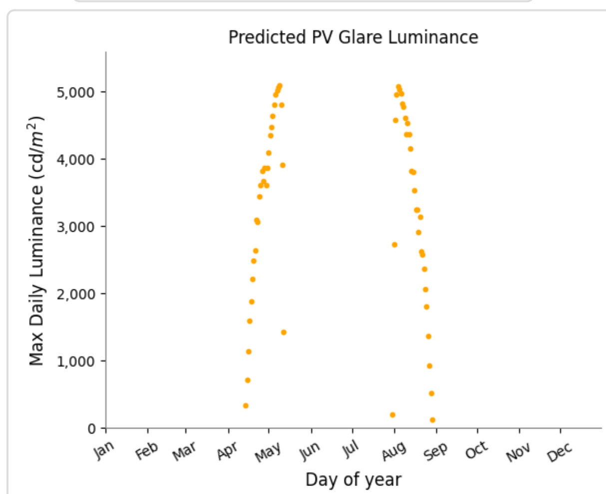












PVA east H and Route: Route 4

No glare found

PVA east H and FP: FP 1

No glare found

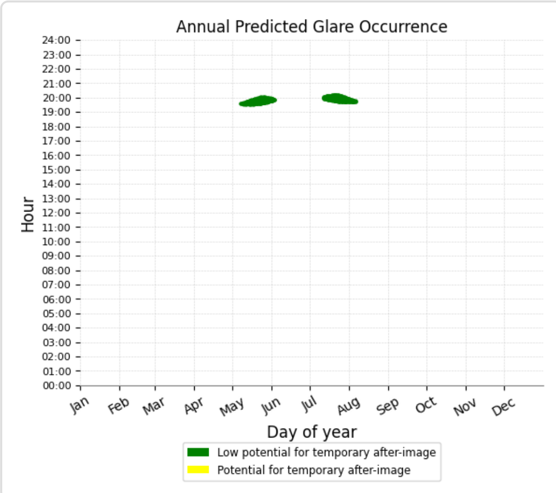
PVA east H and FP: FP 2

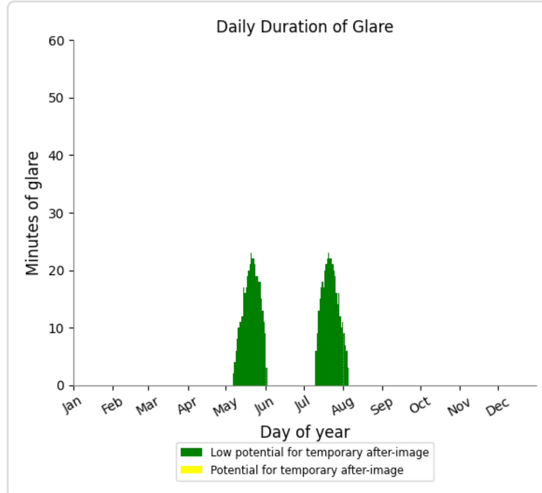
No glare found

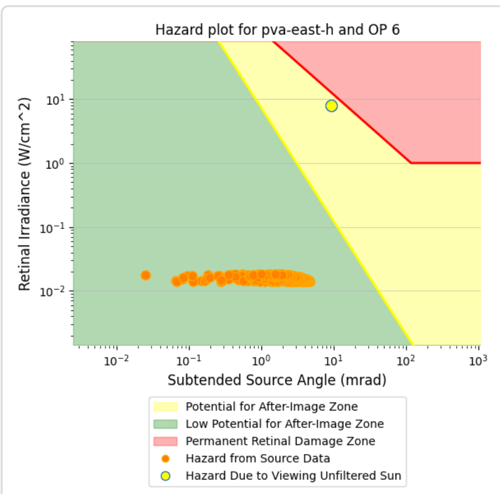
PVA east H and OP 6

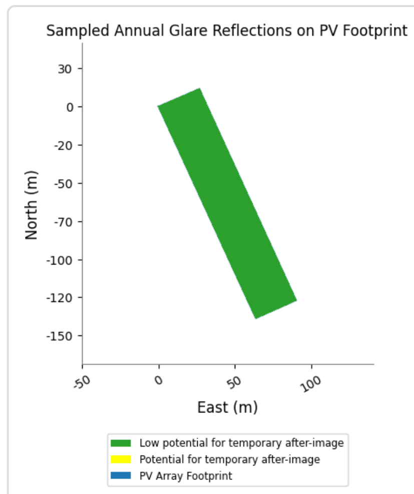
Yellow glare: none

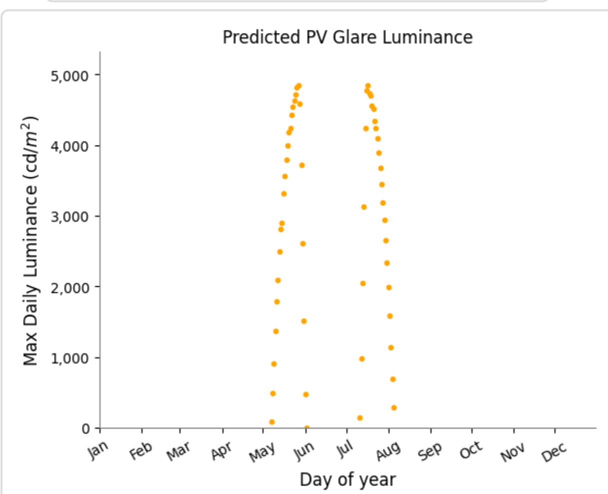
Green glare: 776 min.







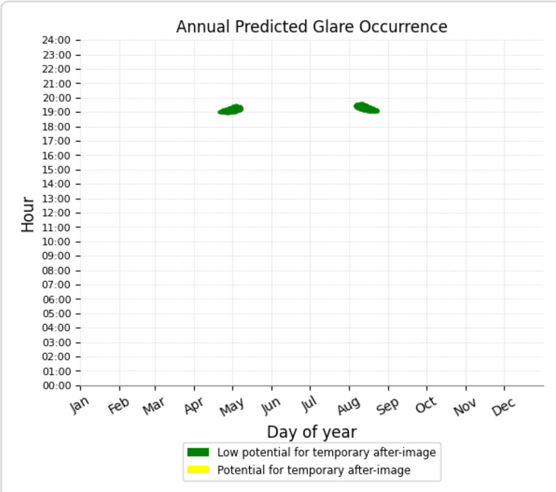


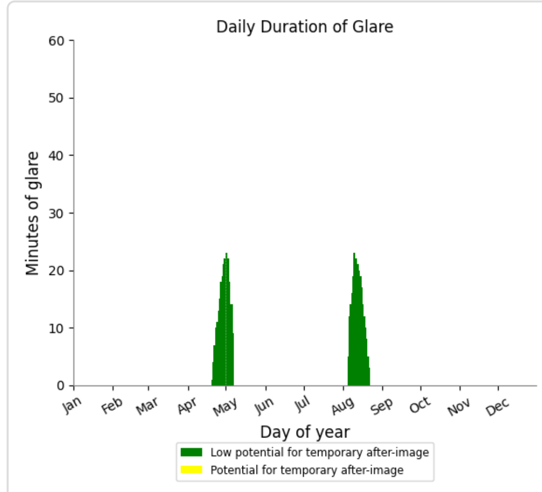


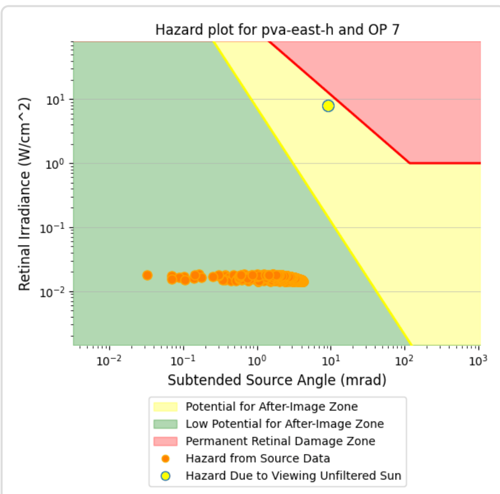
PVA east H and OP 7

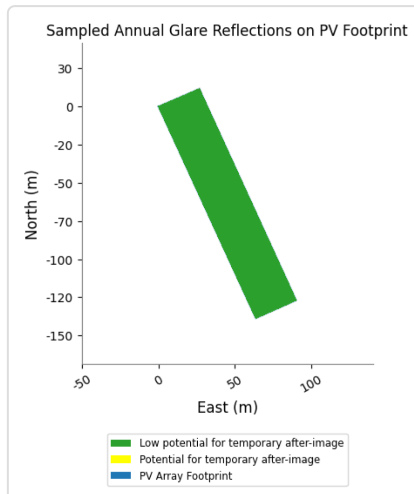
Yellow glare: none

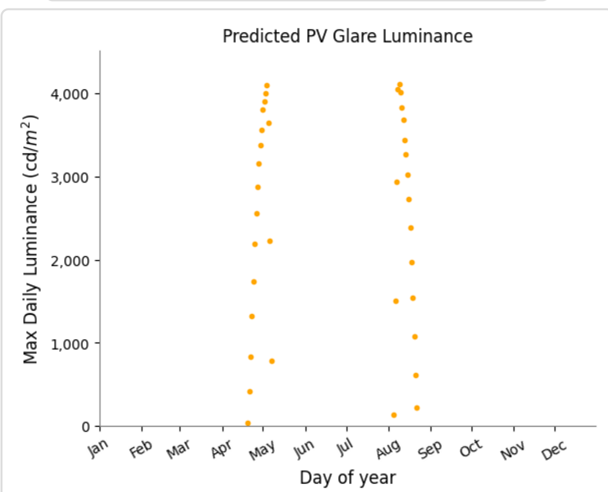
Green glare: 526 min.







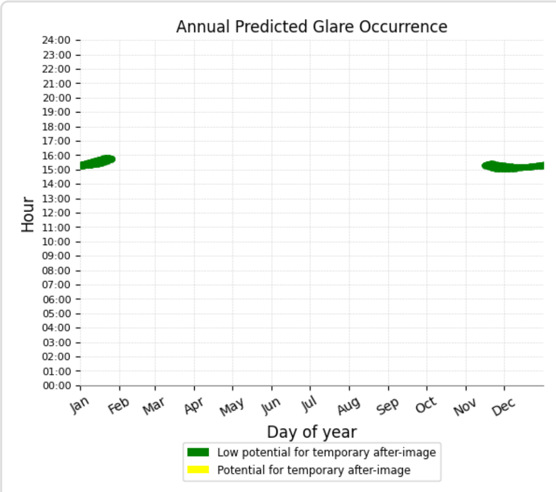


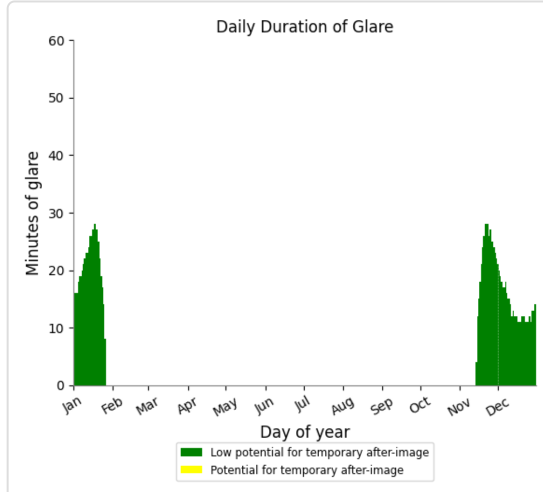


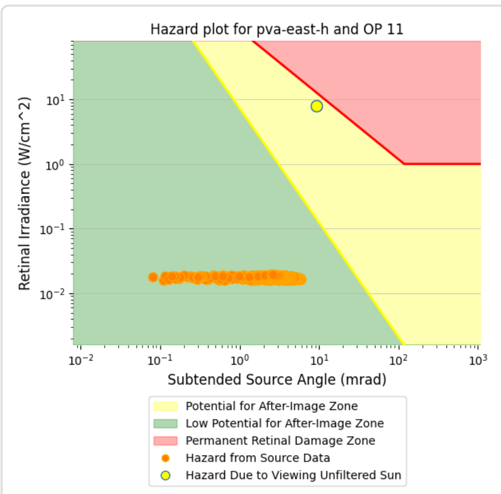
PVA east H and OP 11

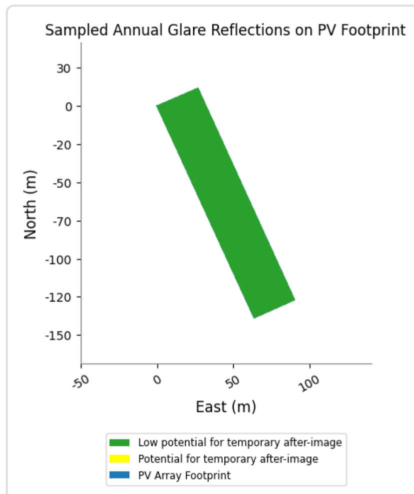
Yellow glare: none

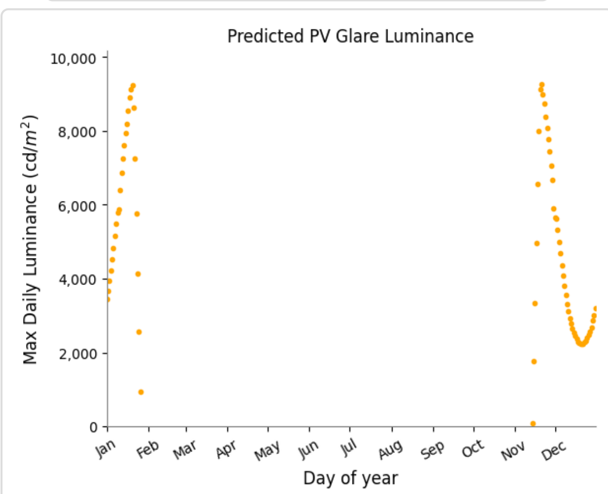
Green glare: 1,351 min.











PVA east H and OP 1

No glare found

PVA east H and OP 2

No glare found

PVA east H and OP 3

No glare found

PVA east H and OP 4

No glare found

PVA east H and OP 5

No glare found

PVA east H and OP 8

No glare found

PVA east H and OP 9

No glare found

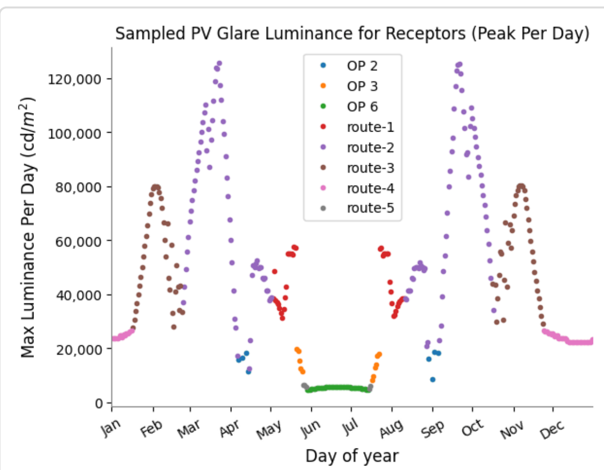
PVA east H and OP 10

No glare found

PV: PVA east L low potential for temporary after-image

Receptor results ordered by category of glare

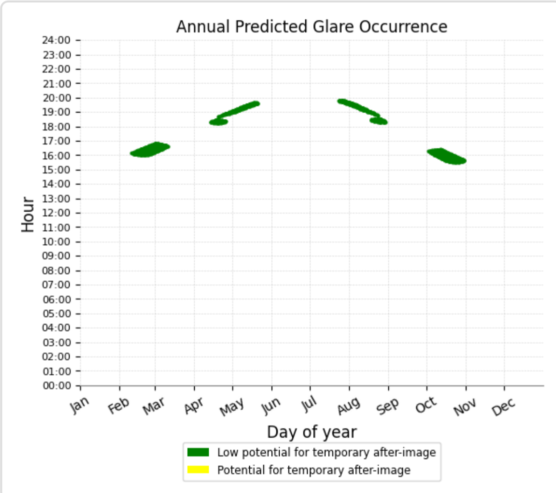
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m²
Route 1	1,813	30.2	0	0.0	57,533
Route 2	2,761	46.0	0	0.0	125,609
Route 3	3,626	60.4	0	0.0	80,268
Route 4	3,386	56.4	0	0.0	27,295
Route 5	1,588	26.5	0	0.0	6,569
FP 1	0	0.0	0	0.0	0
FP 2	0	0.0	0	0.0	0
OP 2	15	0.2	0	0.0	18,795
OP 3	358	6.0	0	0.0	31,342
OP 4	1,145	19.1	0	0.0	48,894
OP 6	1,579	26.3	0	0.0	5,655
OP 7	948	15.8	0	0.0	5,374
OP 11	1,399	23.3	0	0.0	14,196
OP 1	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0

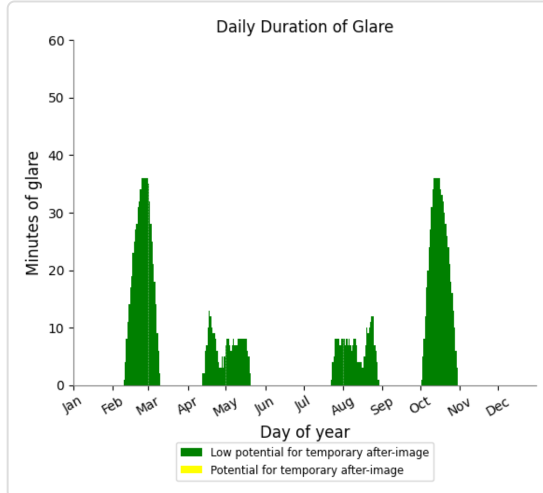


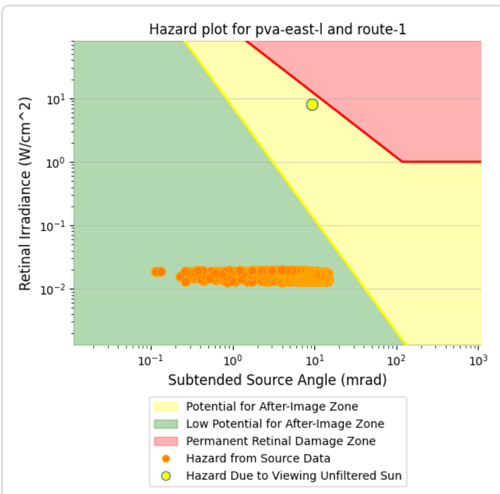
PVA east L and Route: Route 1

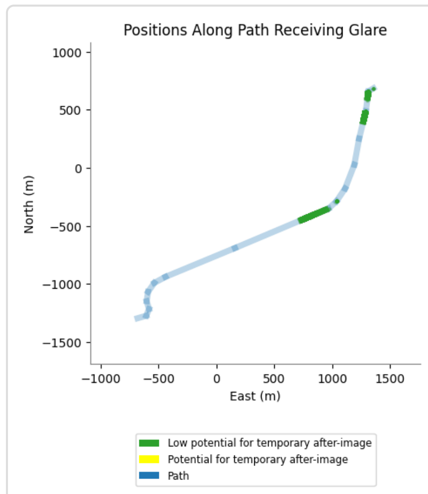
Yellow glare: none

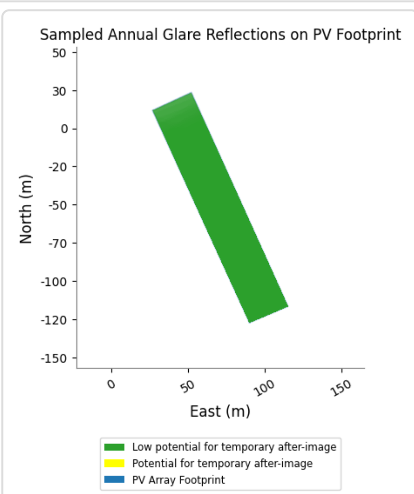
Green glare: 1,813 min.

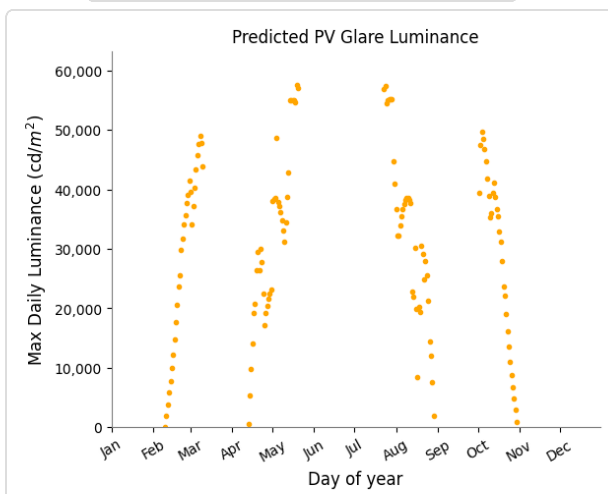








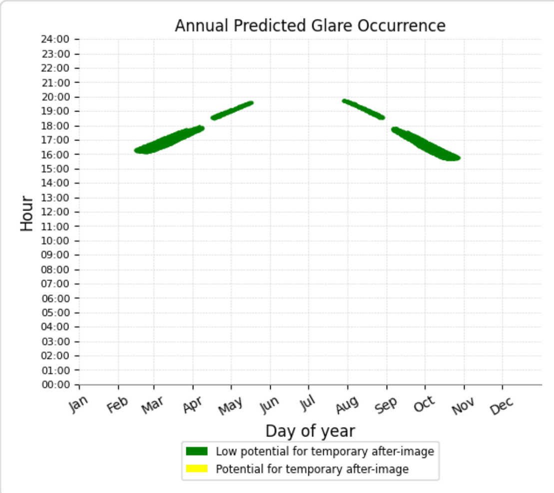


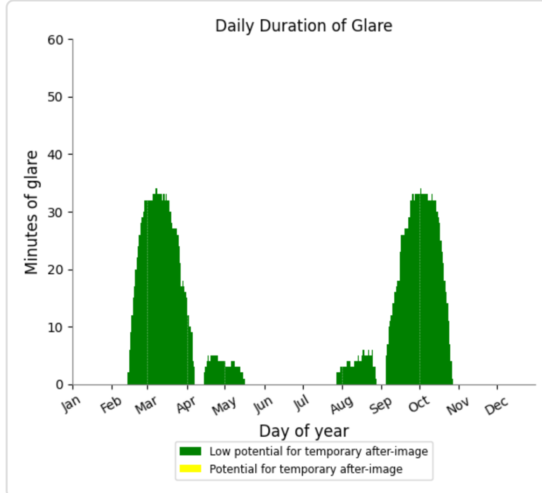


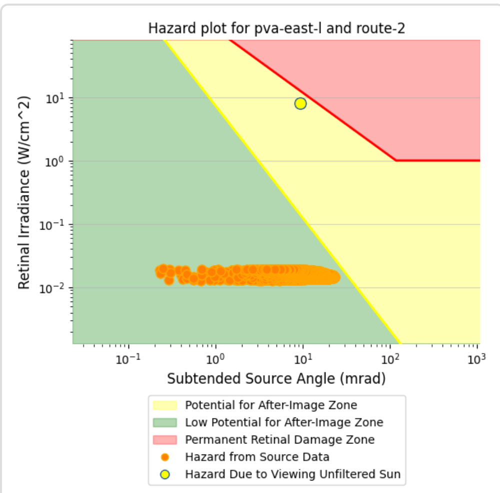
PVA east L and Route: Route 2

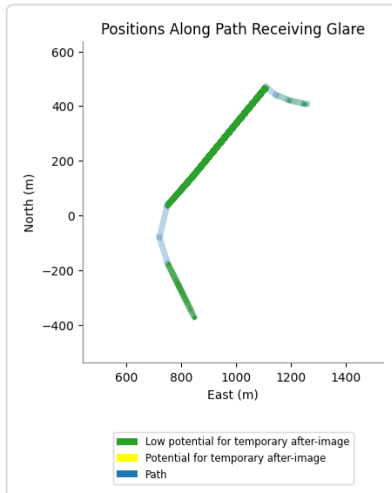
Yellow glare: none

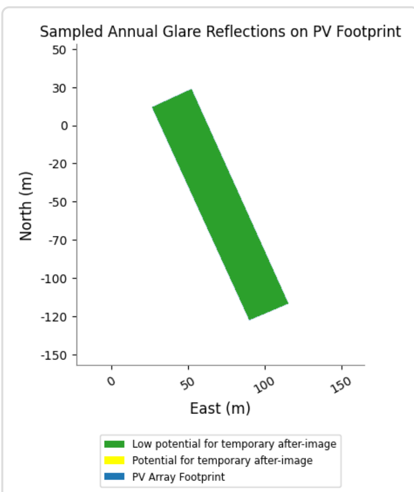
Green glare: 2,761 min.

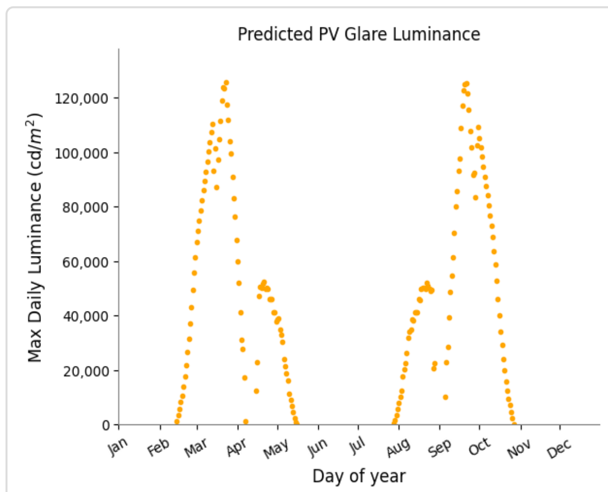








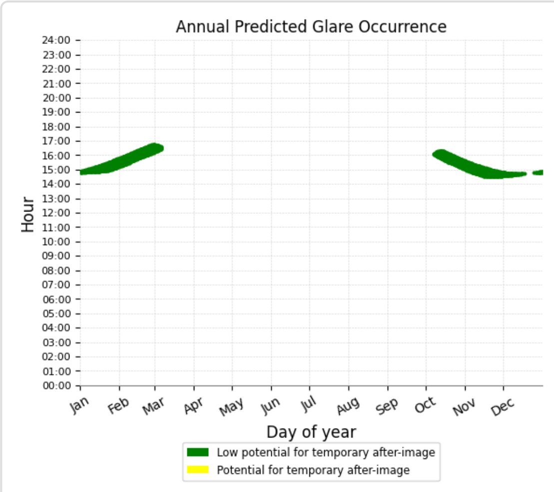


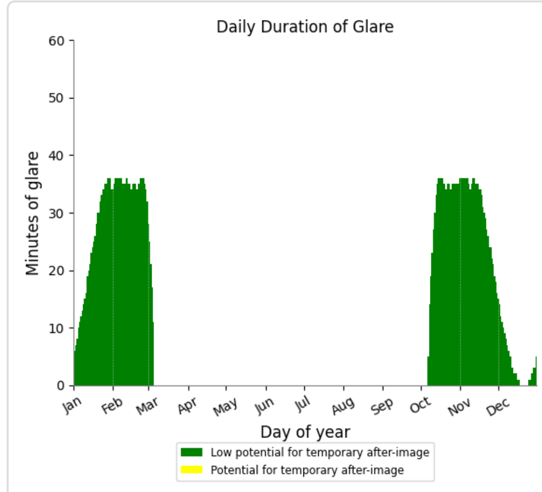


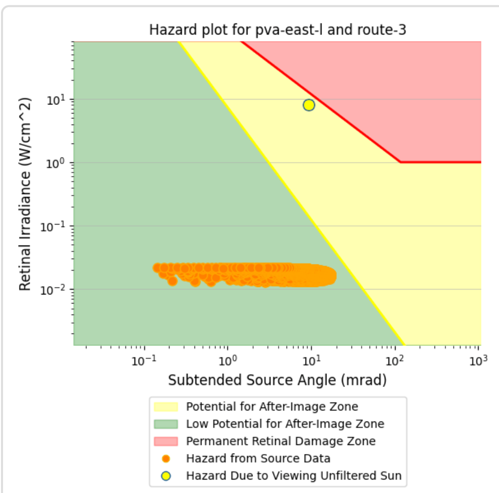
PVA east L and Route: Route 3

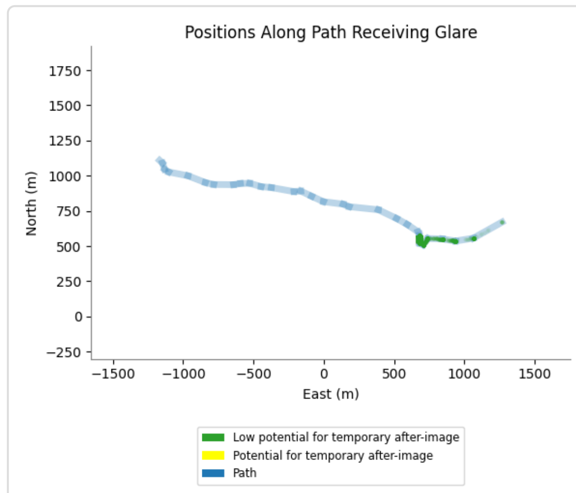
Yellow glare: none

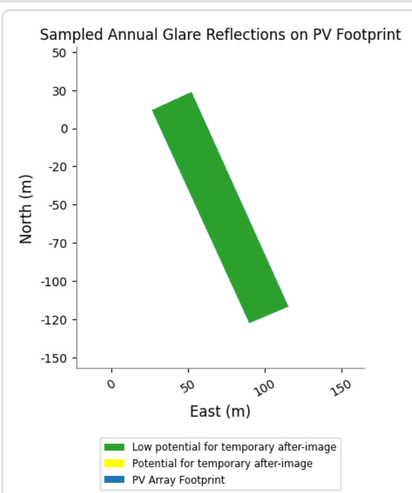
Green glare: 3,626 min.

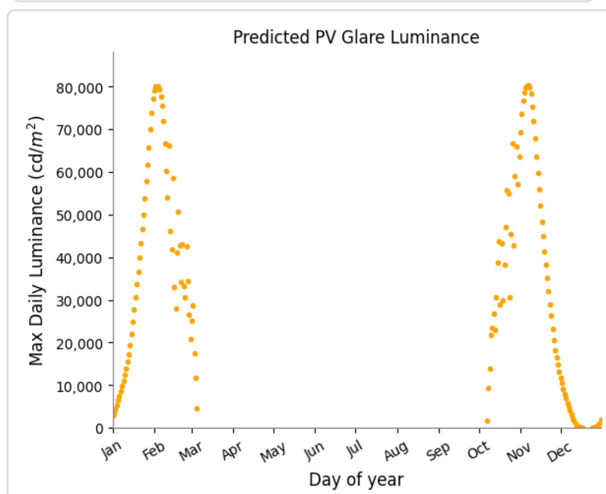








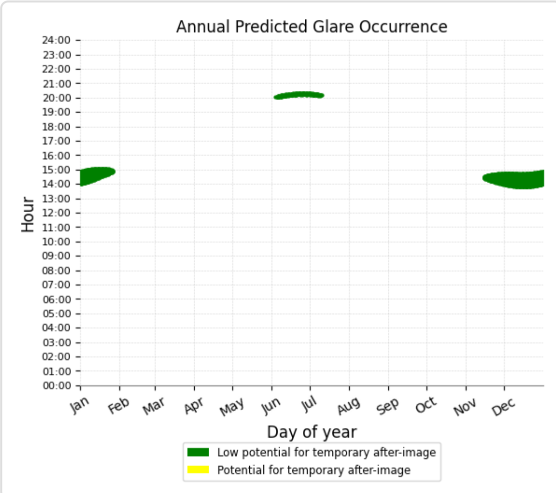


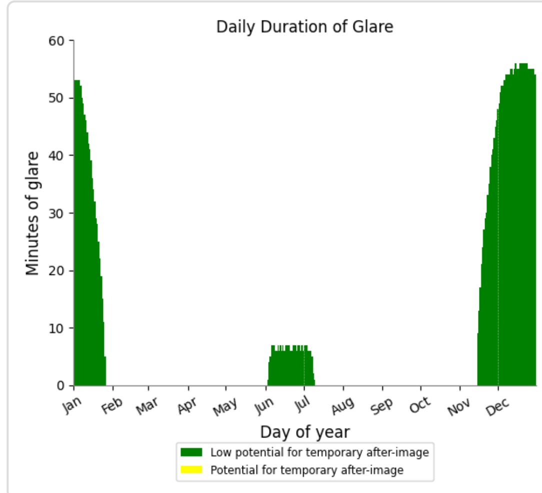


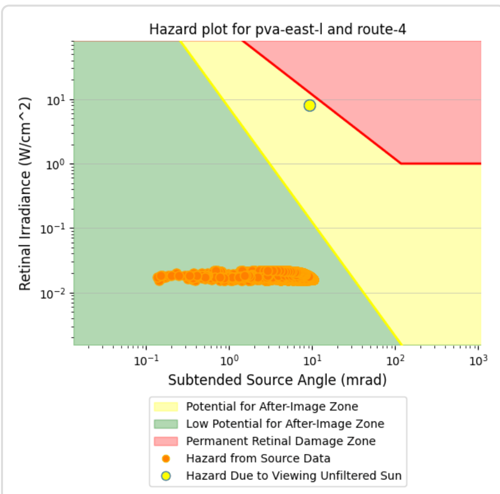
PVA east L and Route: Route 4

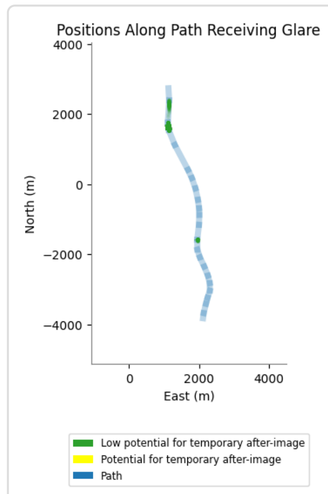
Yellow glare: none

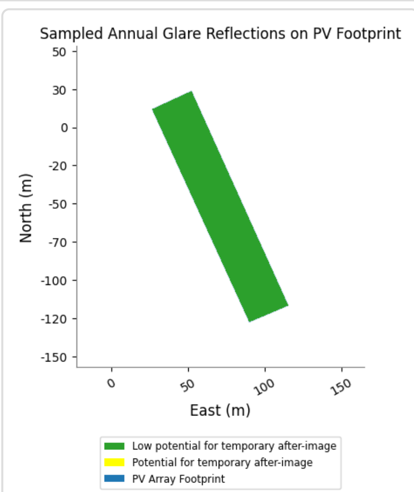
Green glare: 3,386 min.

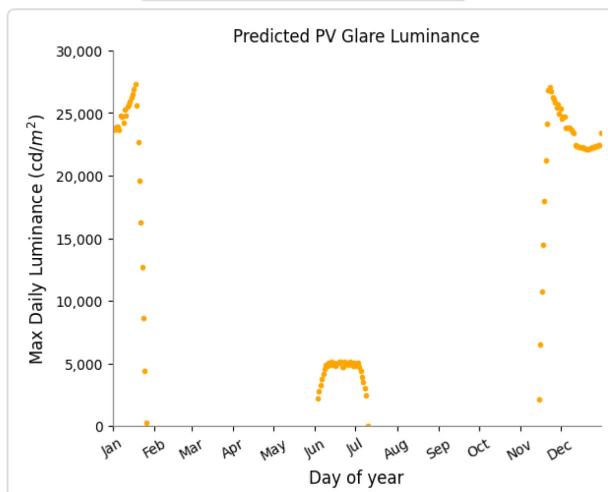








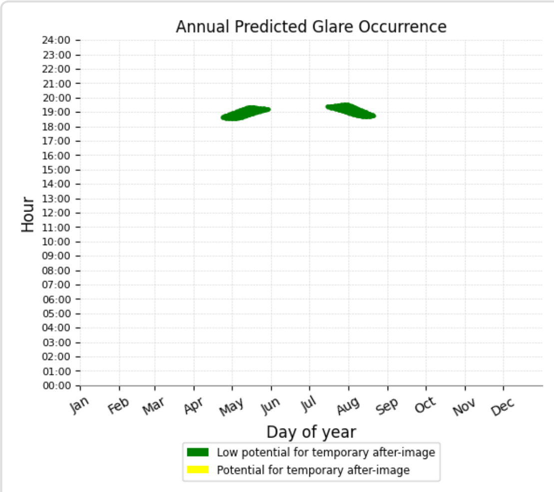


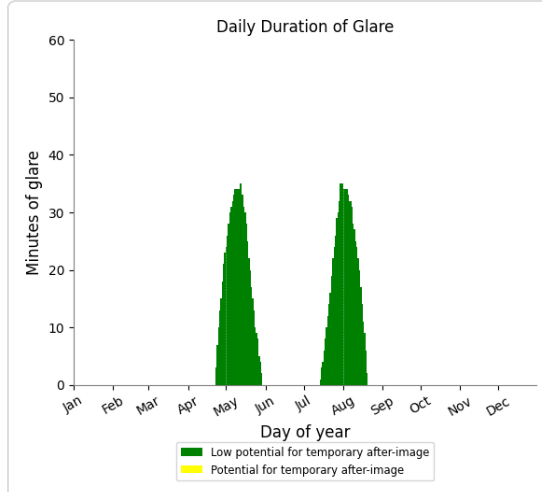


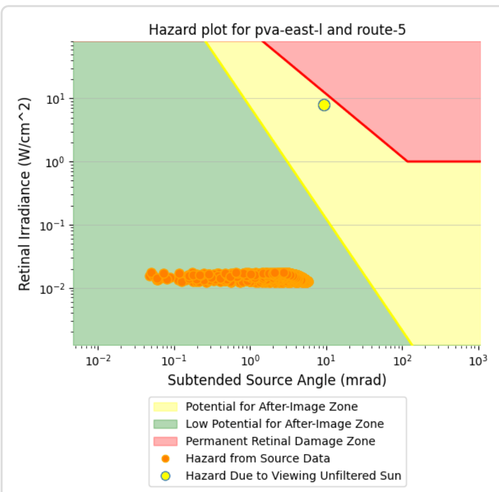
PVA east L and Route: Route 5

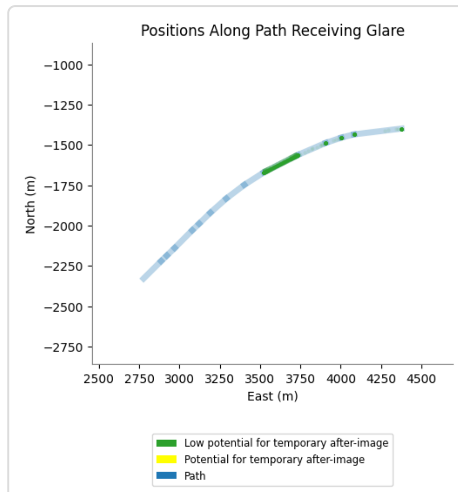
Yellow glare: none

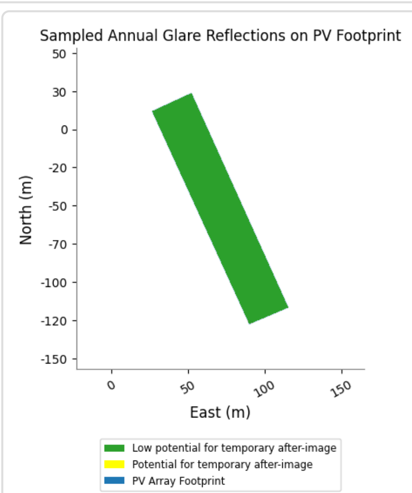
Green glare: 1,588 min.

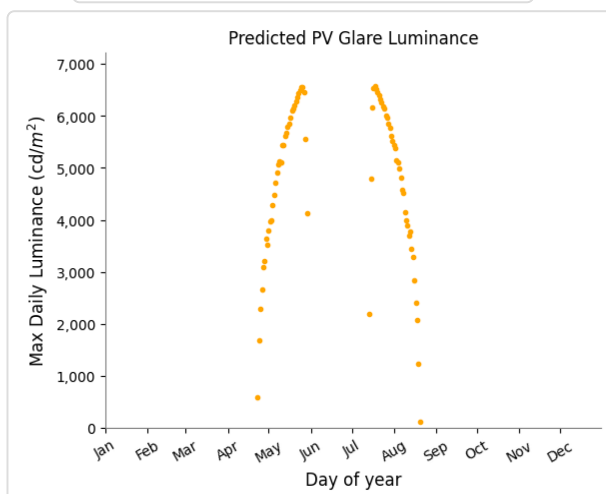












PVA east L and FP: FP 1

No glare found

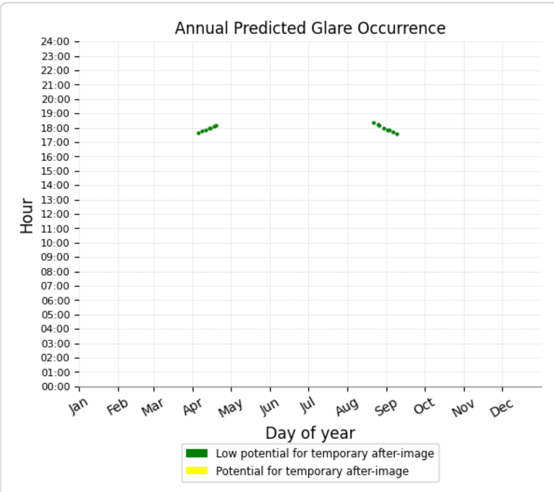
PVA east L and FP: FP 2

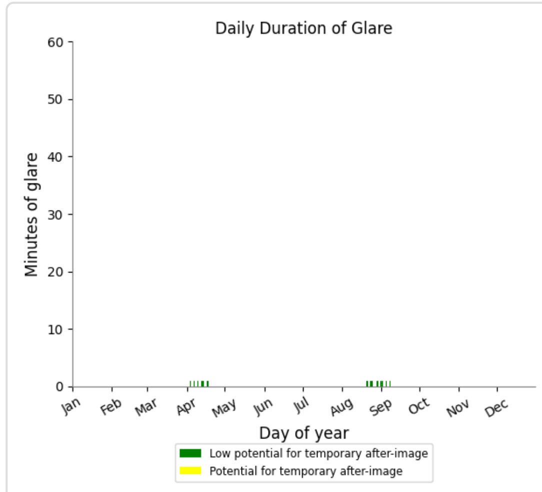
No glare found

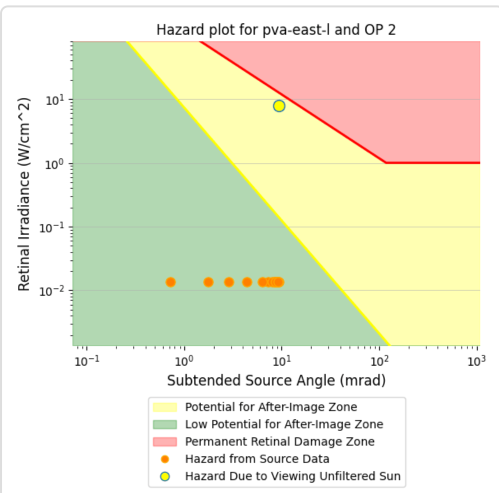
PVA east L and OP 2

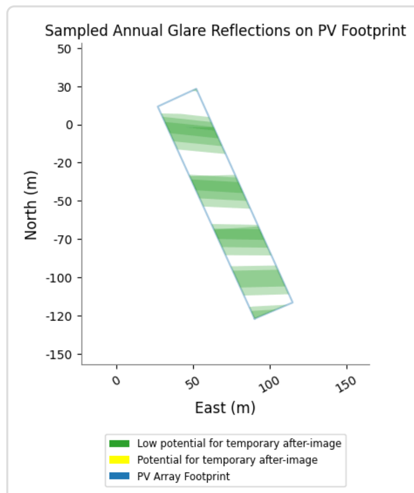
Yellow glare: none

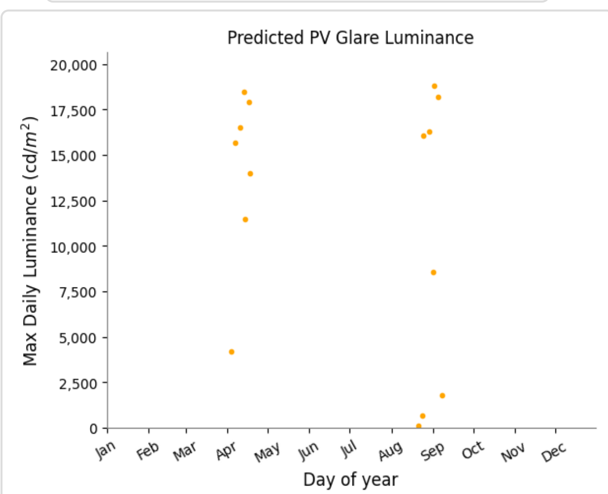
Green glare: 15 min.







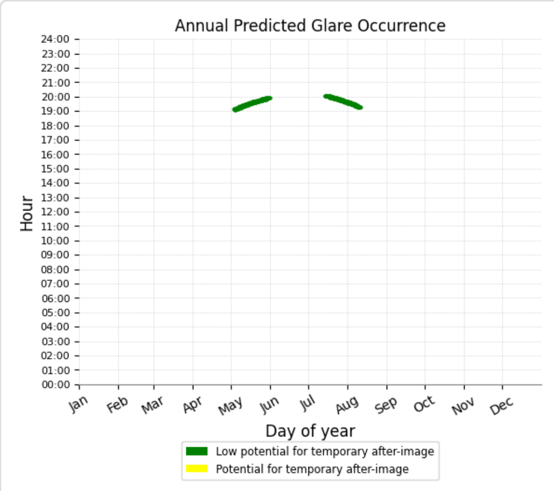


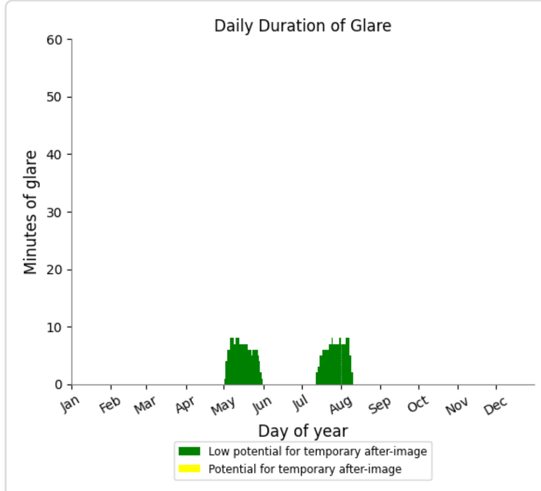


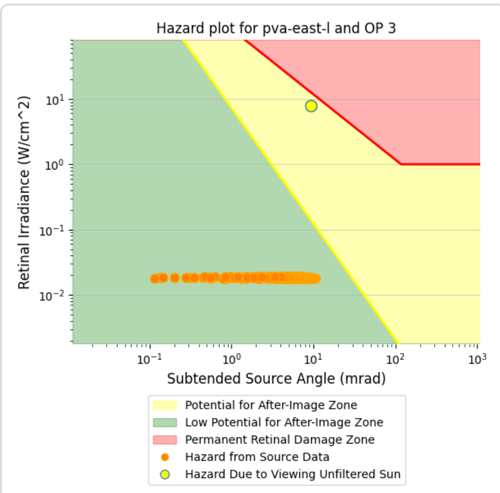
PVA east L and OP 3

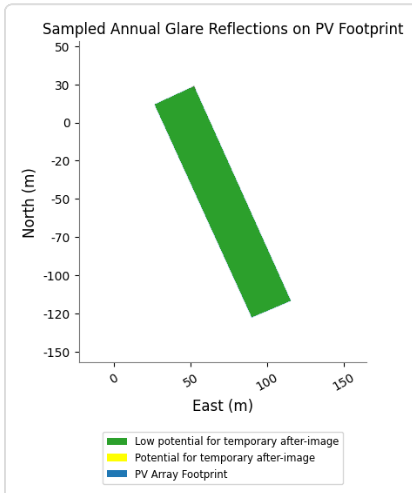
Yellow glare: none

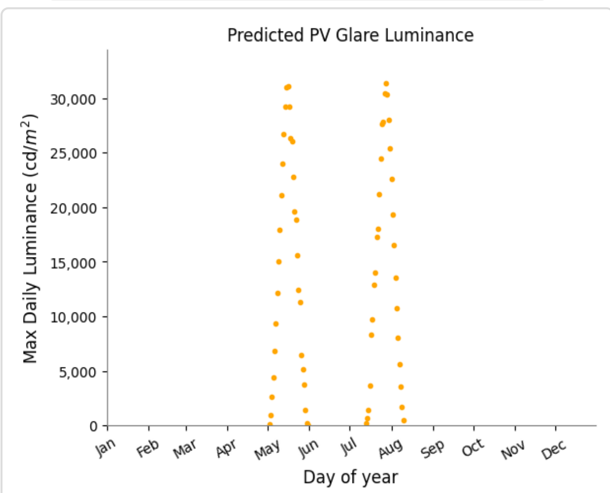
Green glare: 358 min.







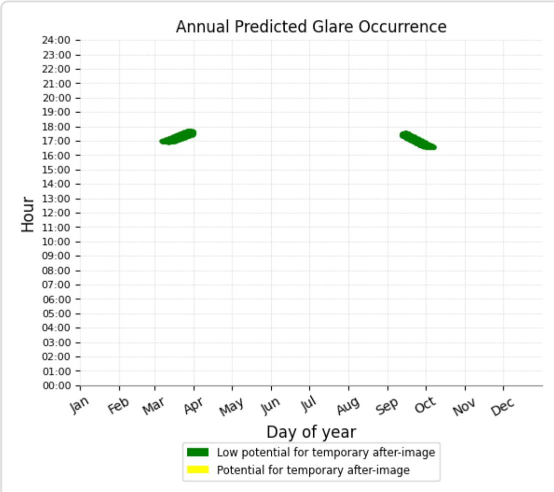


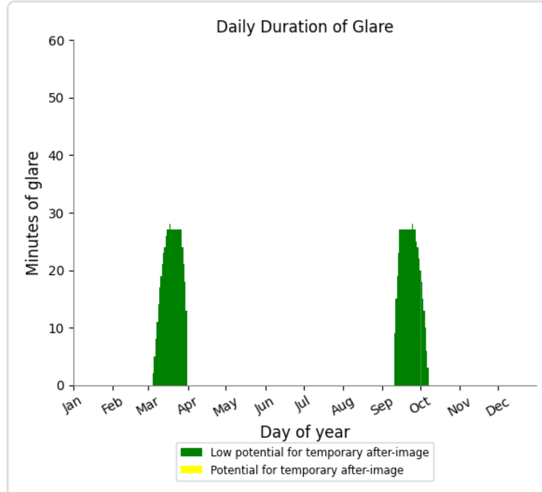


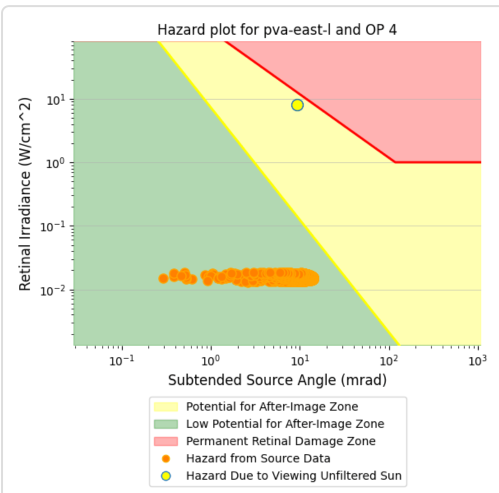
PVA east L and OP 4

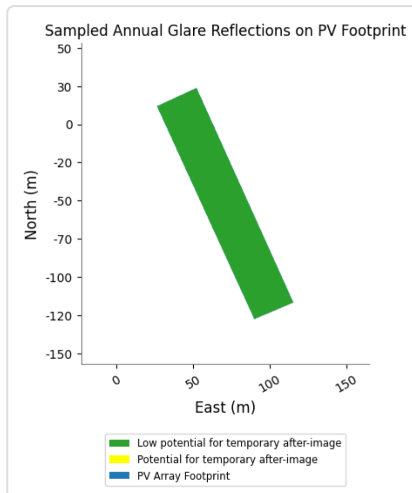
Yellow glare: none

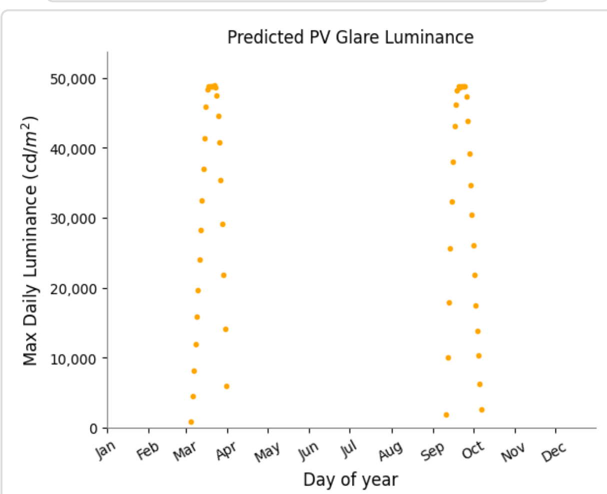
Green glare: 1,145 min.







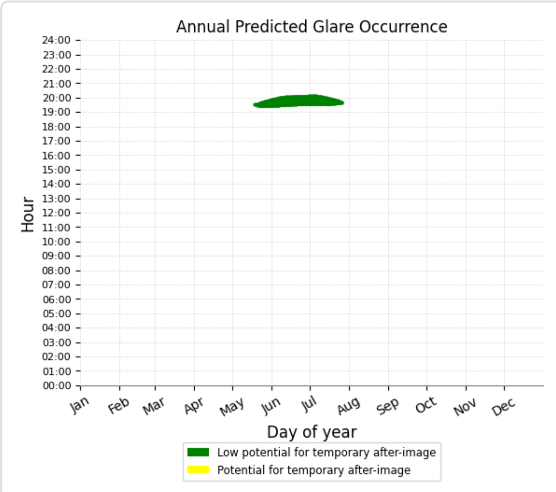


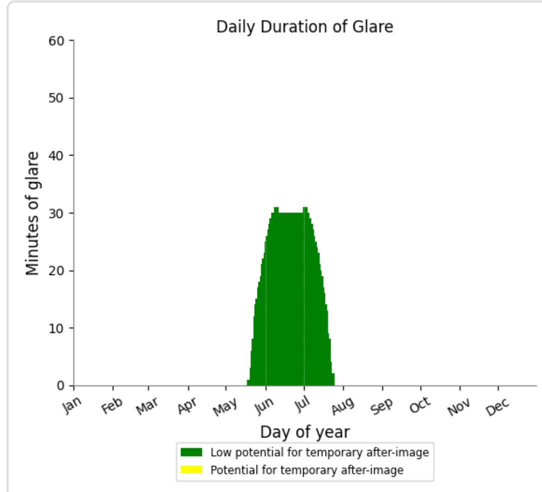


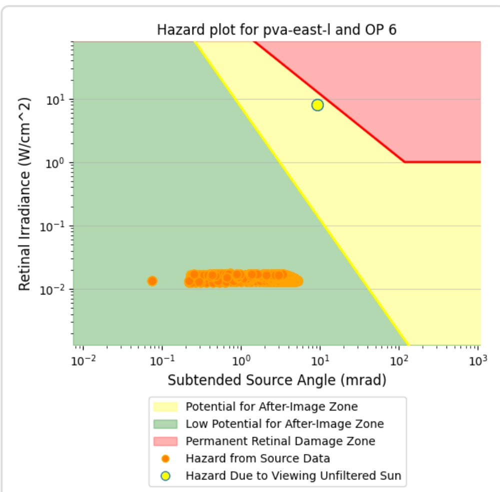
PVA east L and OP 6

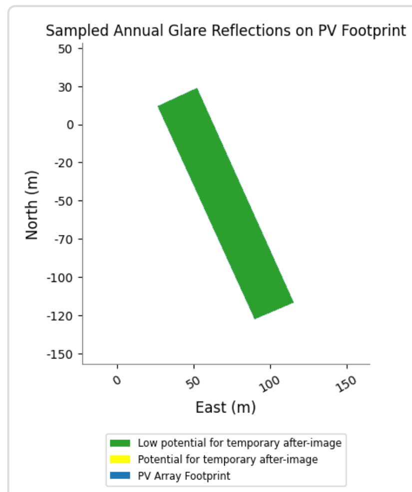
Yellow glare: none

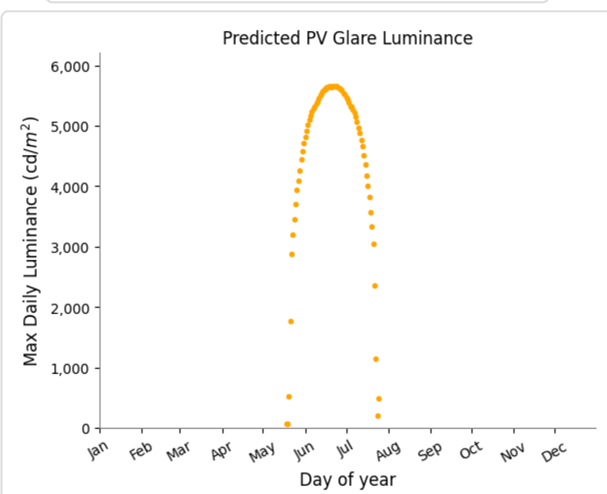
Green glare: 1,579 min.







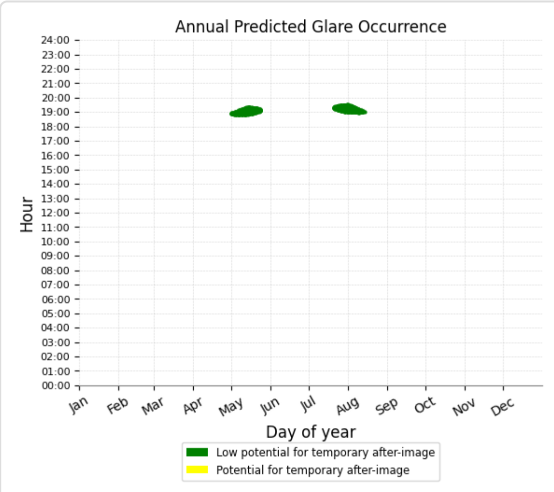


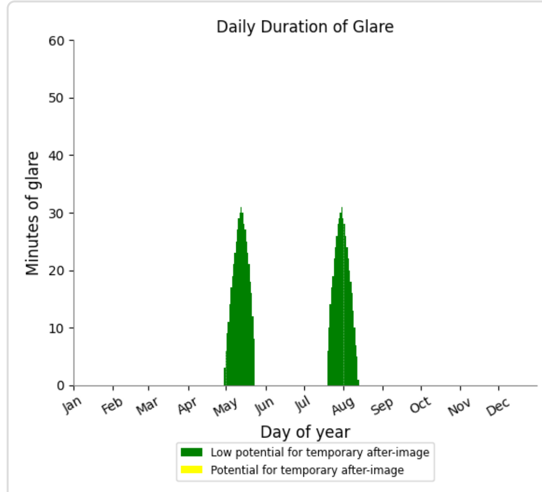


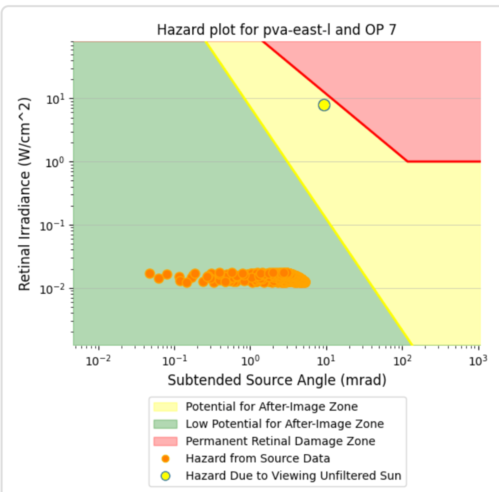
PVA east L and OP 7

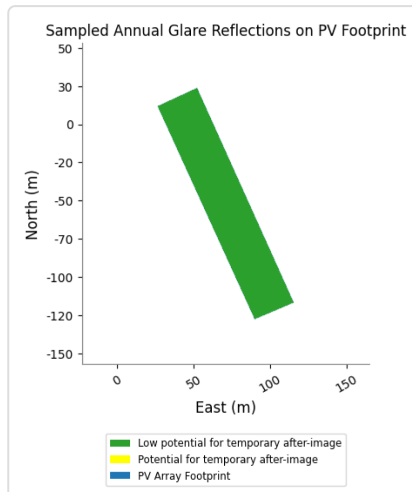
Yellow glare: none

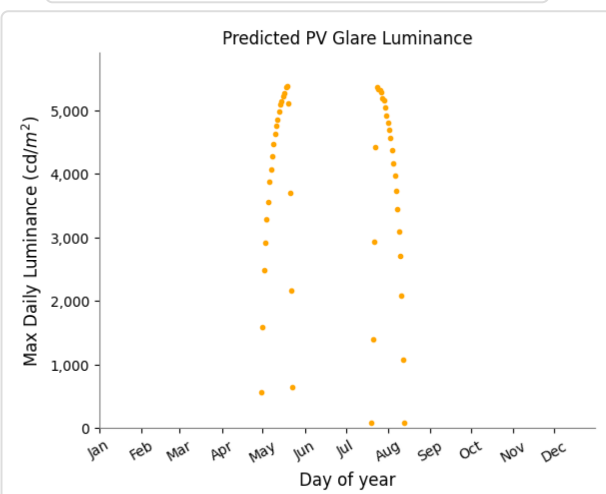
Green glare: 948 min.







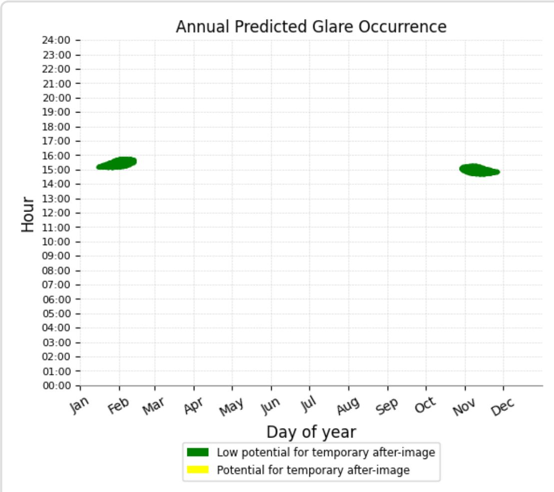


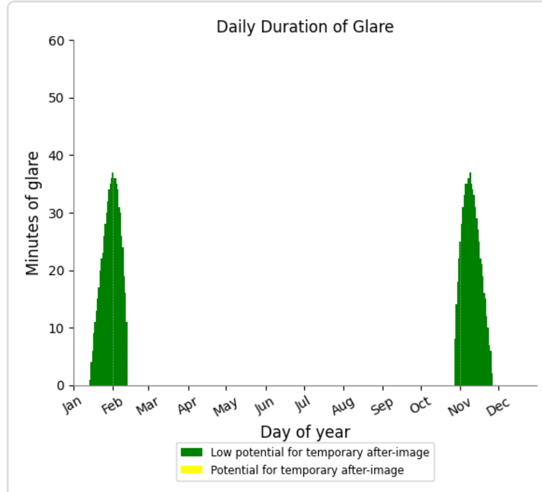


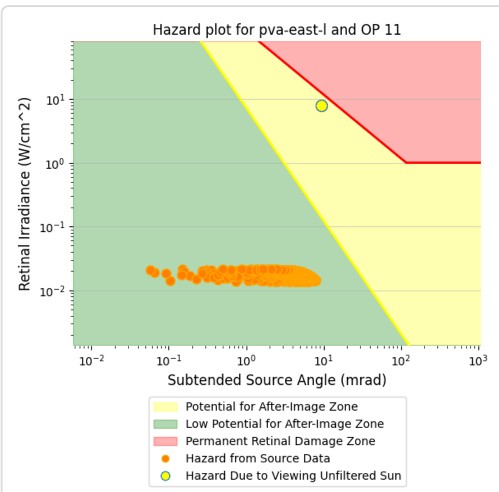
PVA east L and OP 11

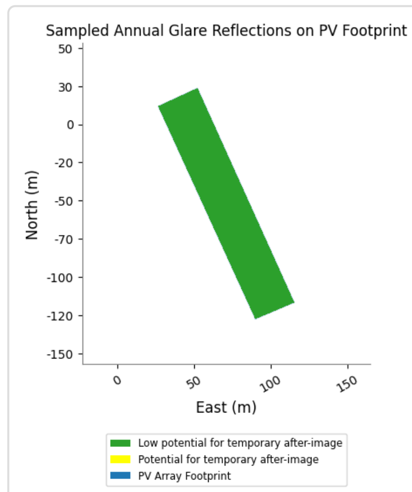
Yellow glare: none

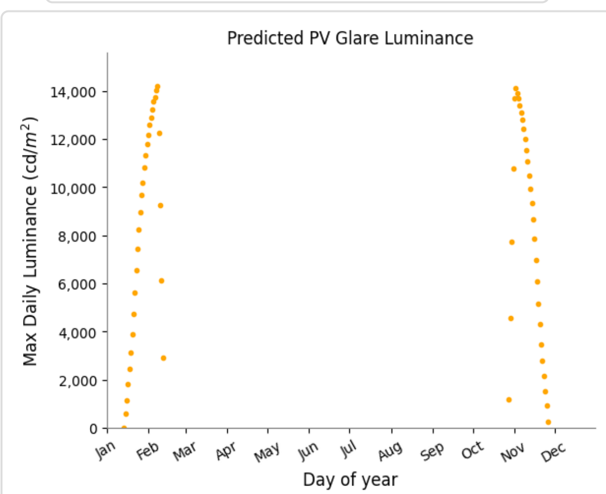
Green glare: 1,399 min.











PVA east L and OP 1

No glare found

PVA east L and OP 5

No glare found

PVA east L and OP 8

No glare found

PVA east L and OP 9

No glare found

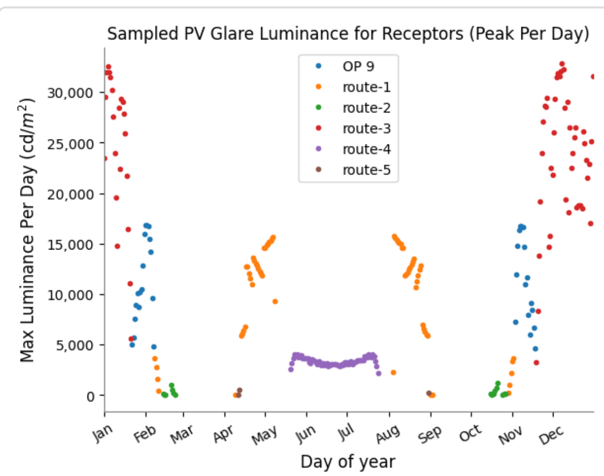
PVA east L and OP 10

No glare found

PV: PVA west H low potential for temporary after-image

Receptor results ordered by category of glare

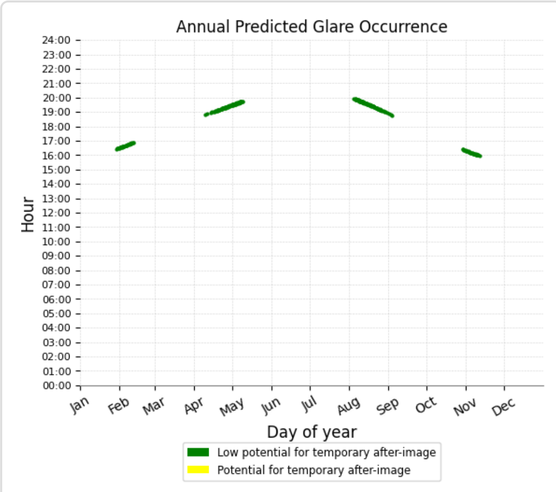
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
Route 1	214	3.6	0	0.0	15,719
Route 2	49	0.8	0	0.0	8,424
Route 3	1,523	25.4	0	0.0	32,817
Route 4	281	4.7	0	0.0	4,080
Route 5	198	3.3	0	0.0	2,103
FP 1	0	0.0	0	0.0	0
FP 2	0	0.0	0	0.0	0
OP 9	360	6.0	0	0.0	16,856
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0

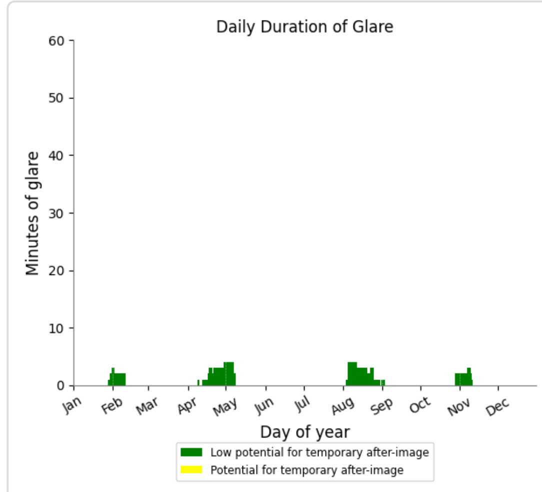


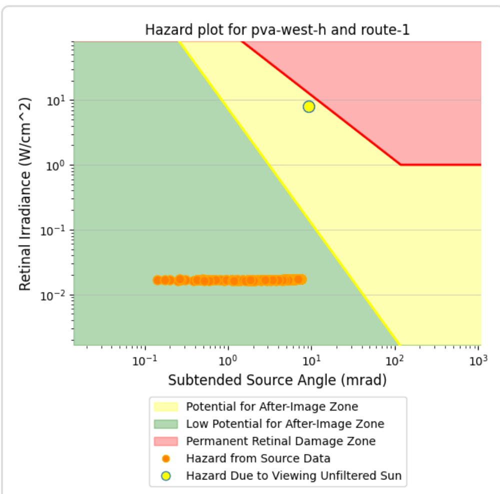
PVA west H and Route: Route 1

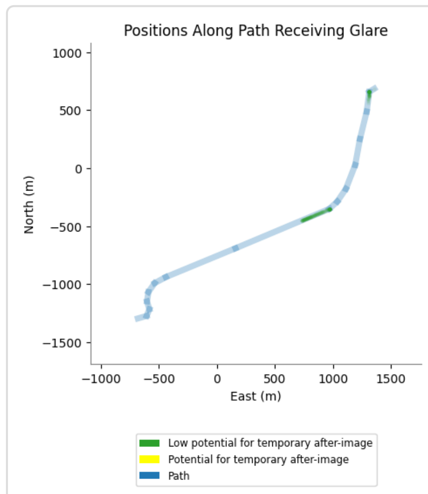
Yellow glare: none

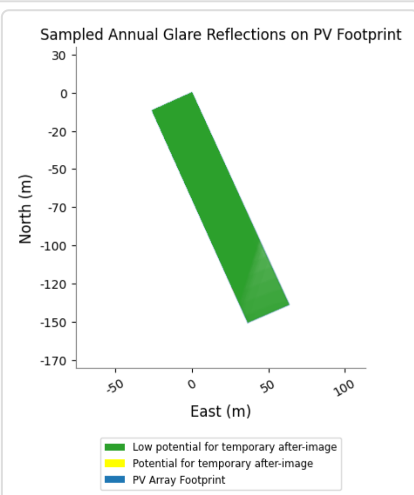
Green glare: 214 min.

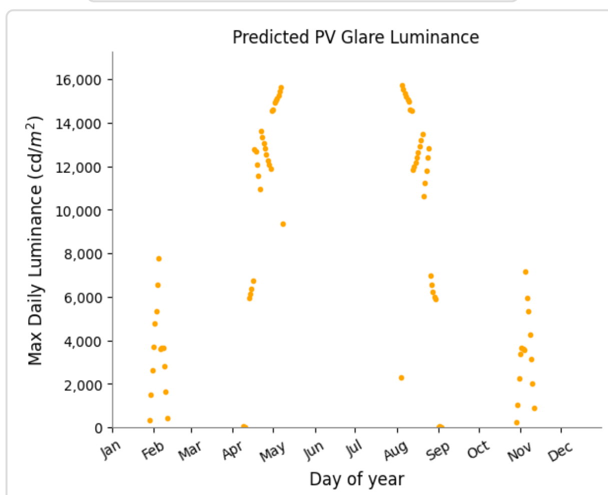








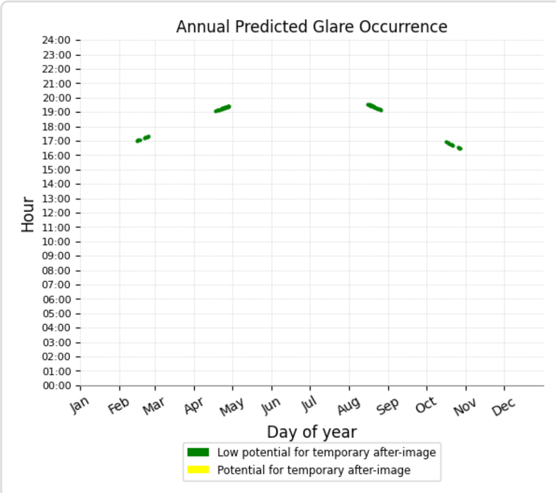


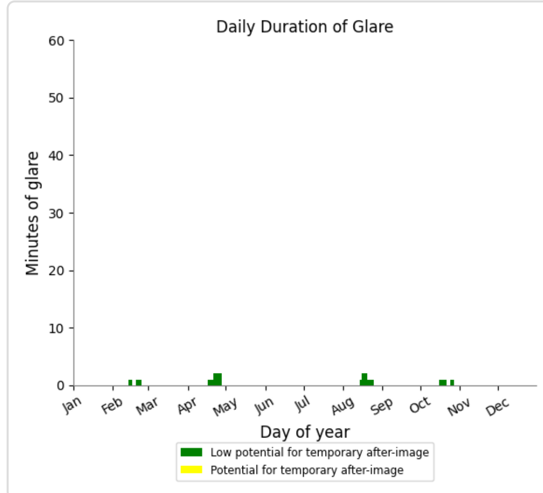


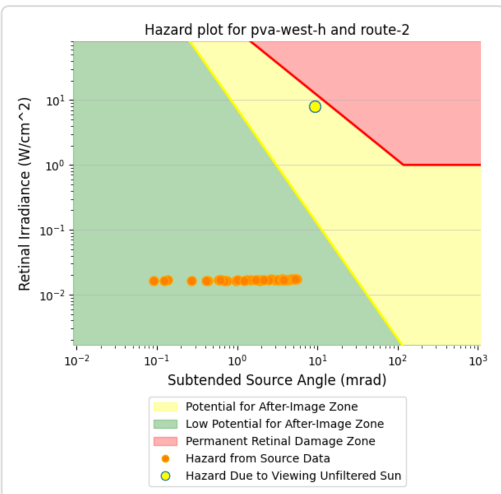
PVA west H and Route: Route 2

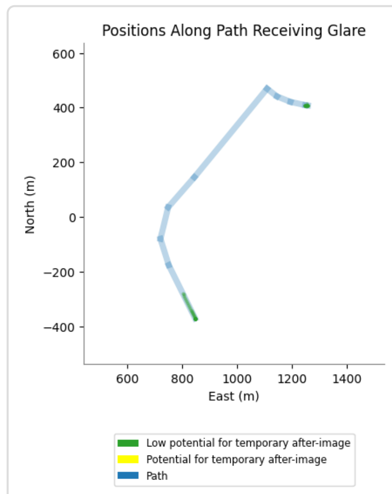
Yellow glare: none

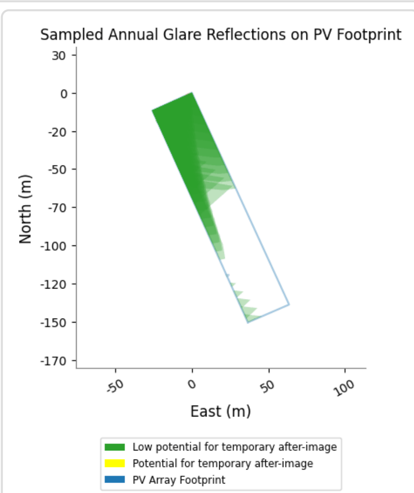
Green glare: 49 min.

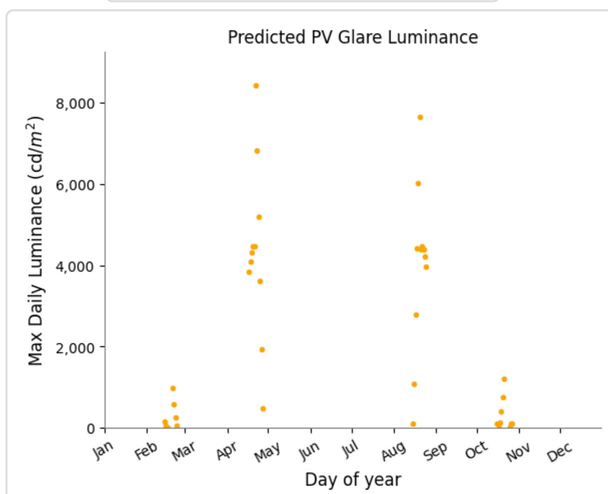








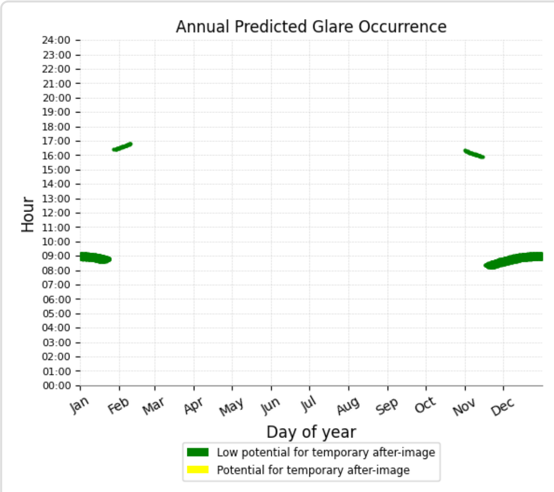


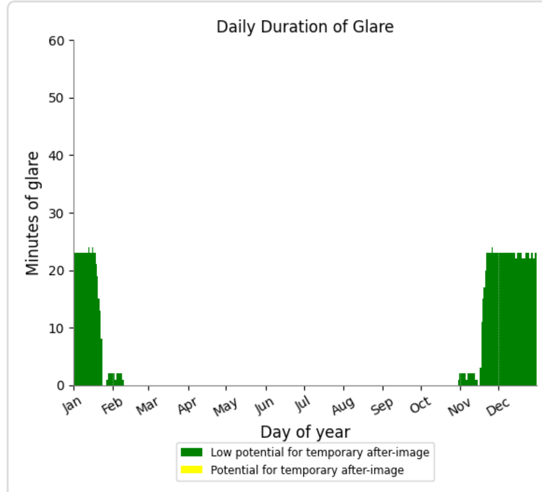


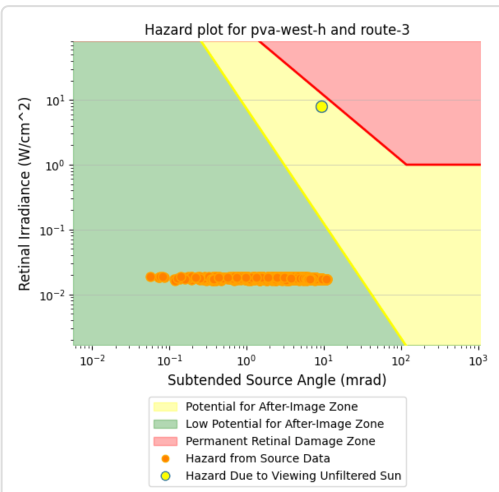
PVA west H and Route: Route 3

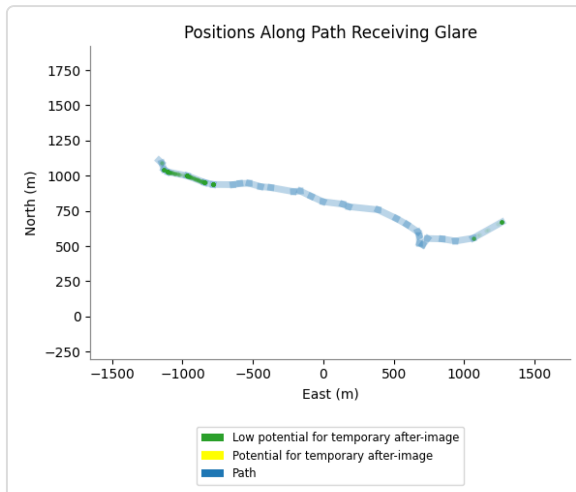
Yellow glare: none

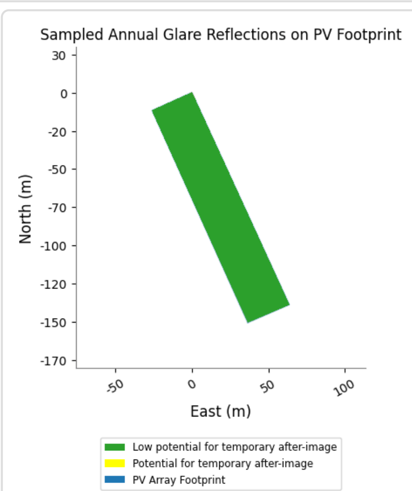
Green glare: 1,523 min.

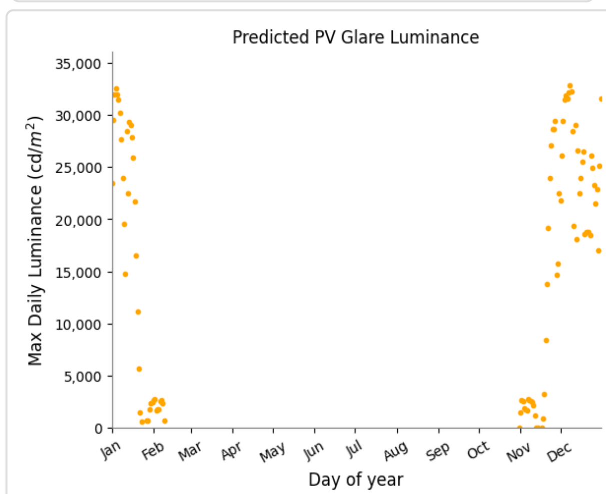








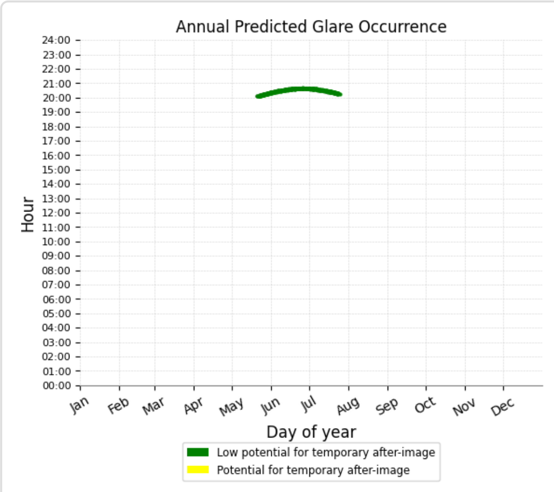


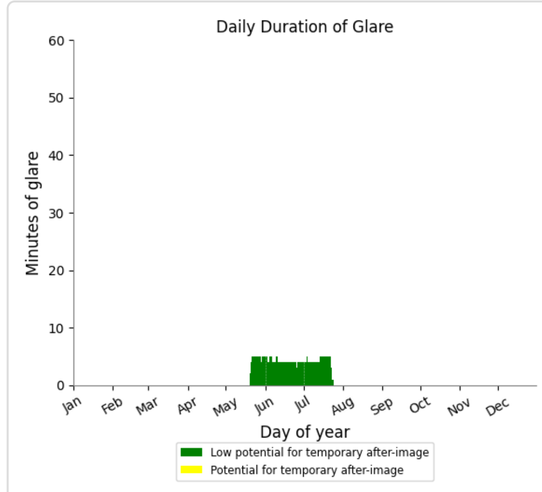


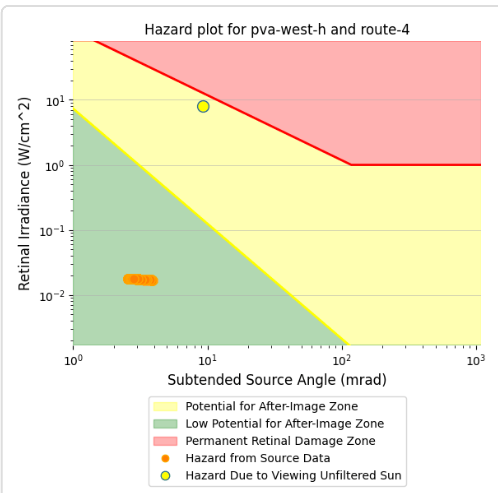
PVA west H and Route: Route 4

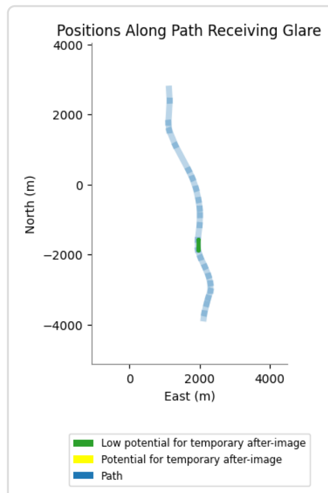
Yellow glare: none

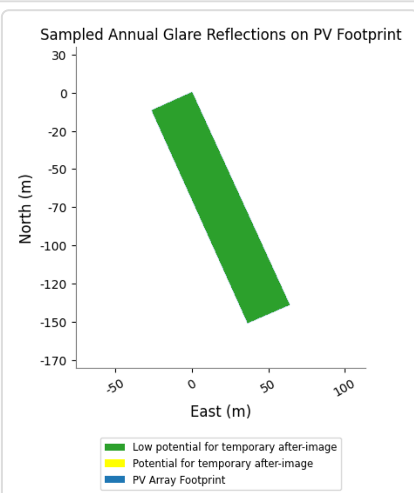
Green glare: 281 min.

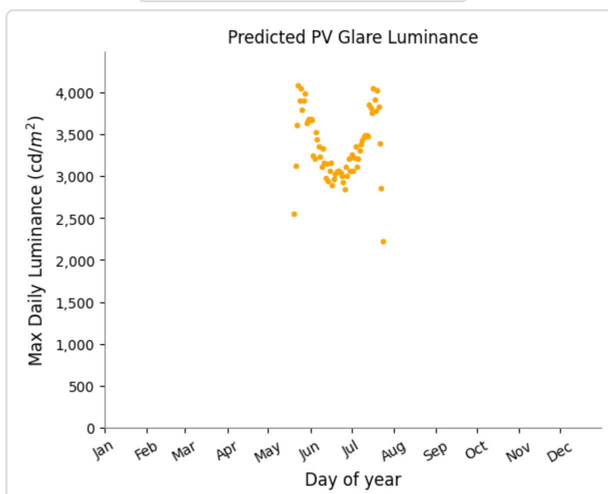






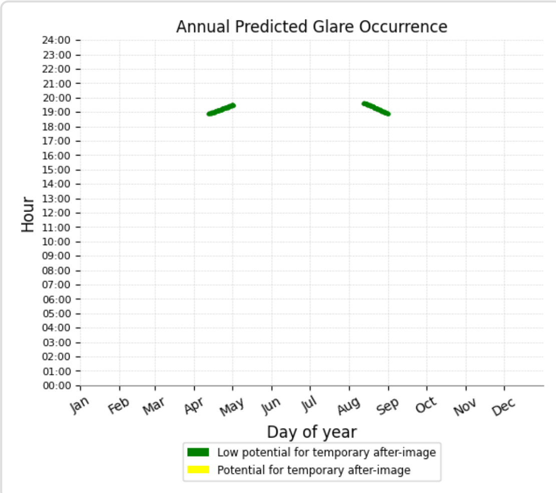


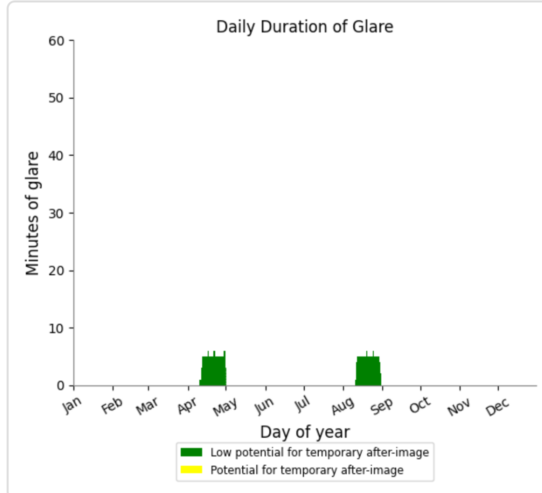


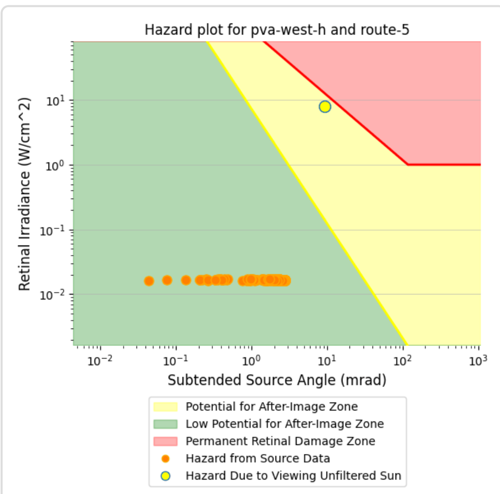


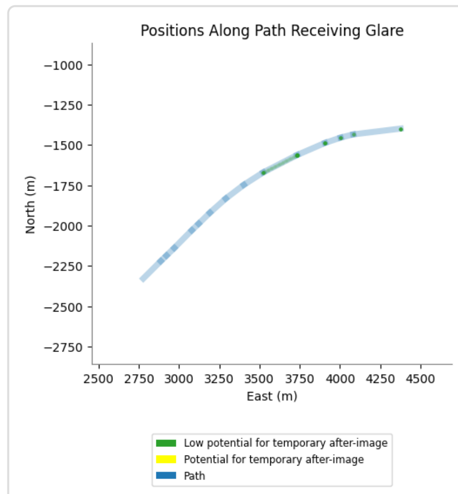
PVA west H and Route: Route 5

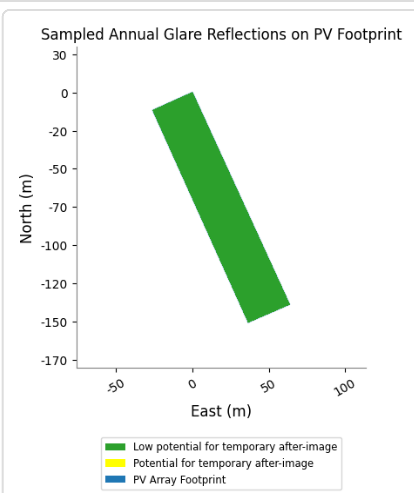
Yellow glare: none
Green glare: 198 min.

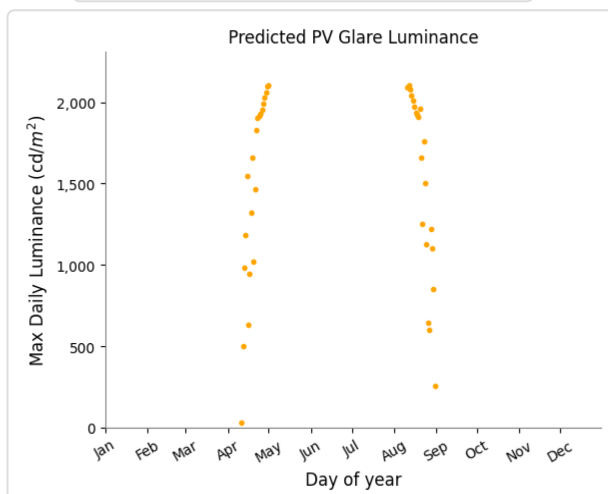












PVA west H and FP: FP 1

No glare found

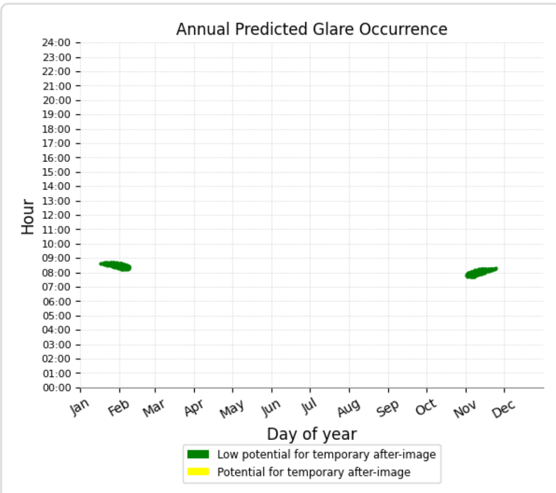
PVA west H and FP: FP 2

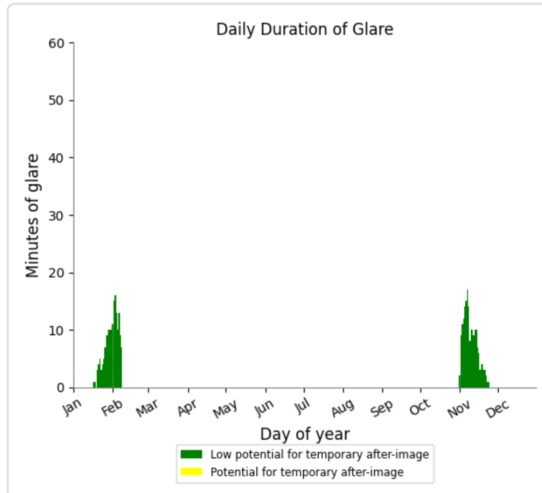
No glare found

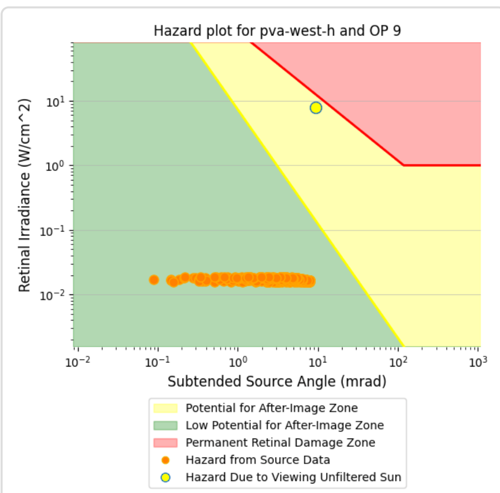
PVA west H and OP 9

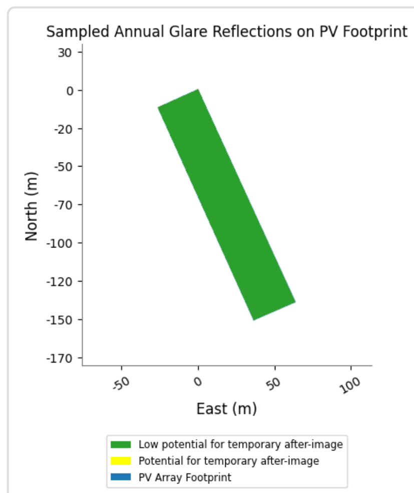
Yellow glare: none

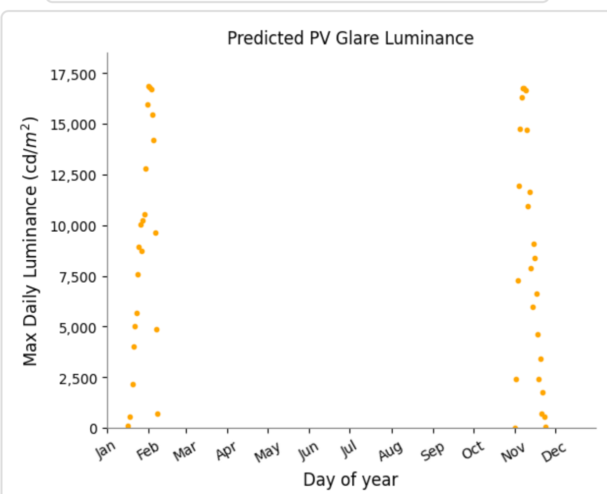
Green glare: 360 min.











PVA west H and OP 1

No glare found

PVA west H and OP 2

No glare found

PVA west H and OP 3

No glare found

PVA west H and OP 4

No glare found

PVA west H and OP 5

No glare found

PVA west H and OP 6

No glare found

PVA west H and OP 7

No glare found

PVA west H and OP 8

No glare found

PVA west H and OP 10

No glare found

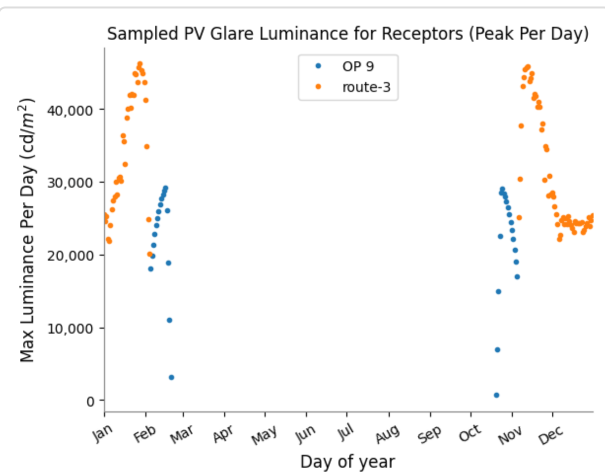
PVA west H and OP 11

No glare found

PV: PVA west L low potential for temporary after-image

Receptor results ordered by category of glare

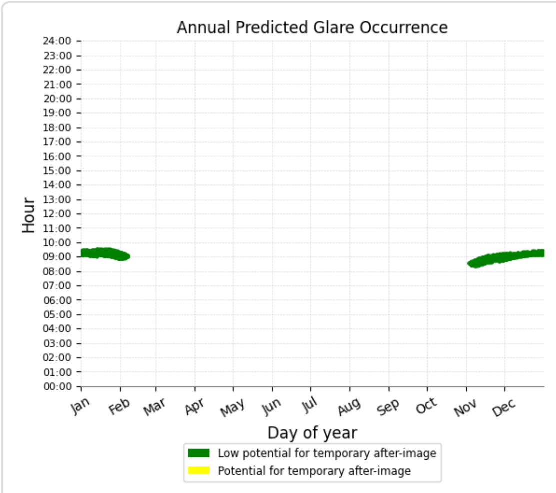
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
Route 3	1,726	28.8	0	0.0	46,227
Route 1	0	0.0	0	0.0	0
Route 2	0	0.0	0	0.0	0
Route 4	0	0.0	0	0.0	0
Route 5	0	0.0	0	0.0	0
FP 1	0	0.0	0	0.0	0
FP 2	0	0.0	0	0.0	0
OP 9	767	12.8	0	0.0	29,188
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0

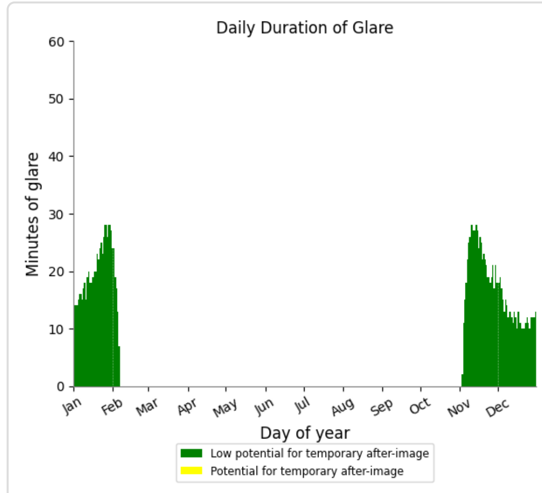


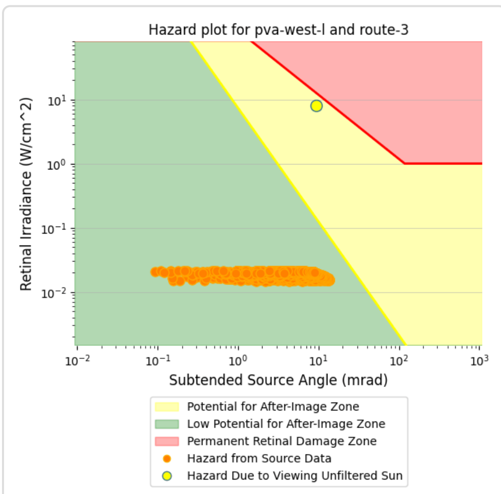
PVA west L and Route: Route 3

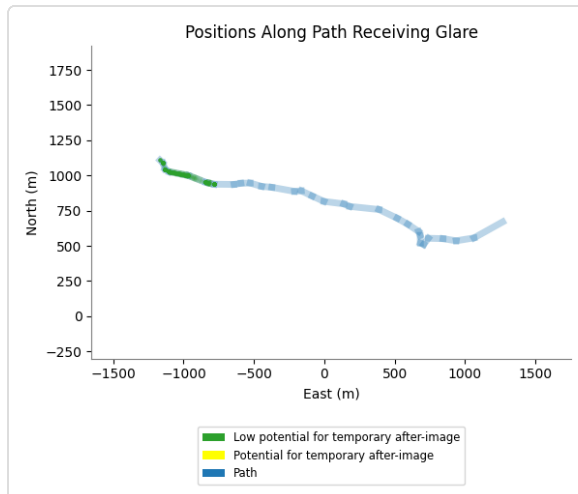
Yellow glare: none

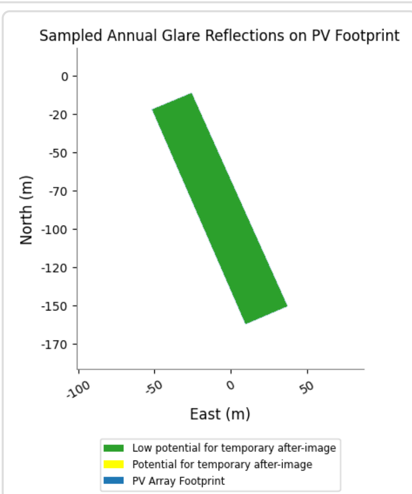
Green glare: 1,726 min.

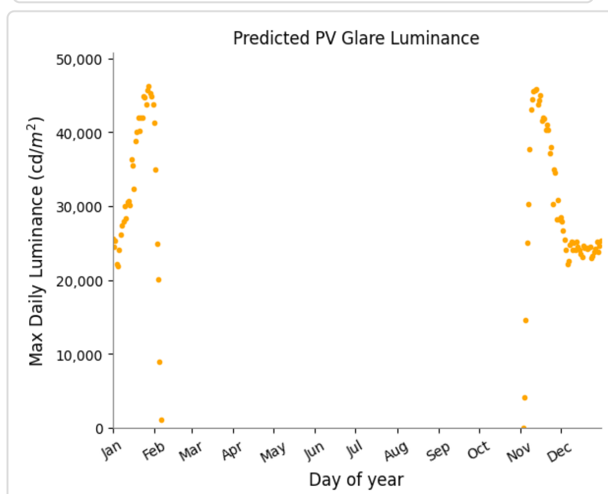












PVA west L and Route: Route 1

No glare found

PVA west L and Route: Route 2

No glare found

PVA west L and Route: Route 4

No glare found

PVA west L and Route: Route 5

No glare found

PVA west L and FP: FP 1

No glare found

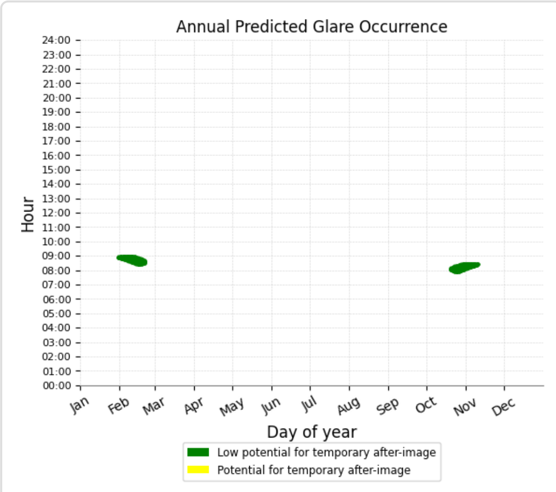
PVA west L and FP: FP 2

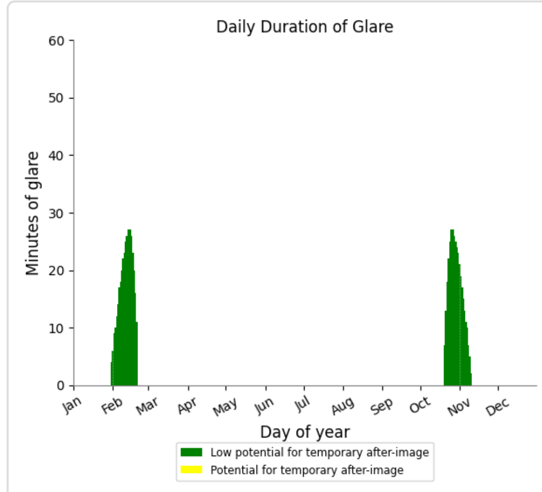
No glare found

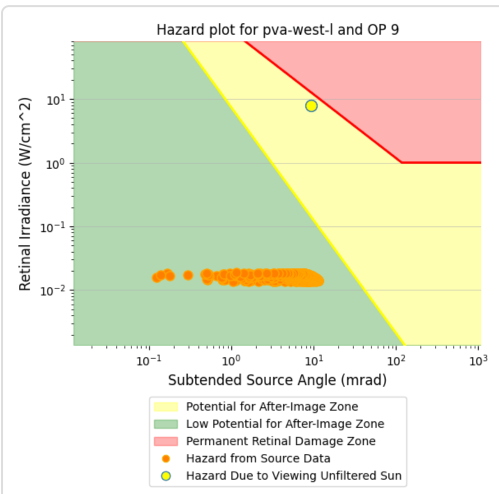
PVA west L and OP 9

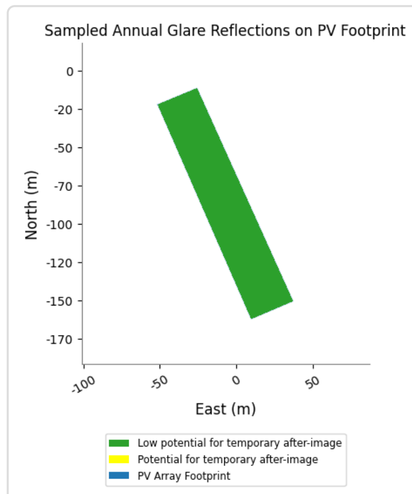
Yellow glare: none

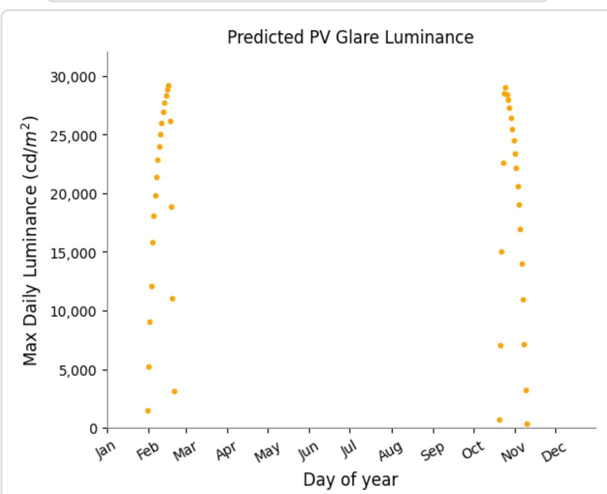
Green glare: 767 min.











PVA west L and OP 1

No glare found

PVA west L and OP 2

No glare found

PVA west L and OP 3

No glare found

PVA west L and OP 4

No glare found

PVA west L and OP 5

No glare found

PVA west L and OP 6

No glare found

PVA west L and OP 7

No glare found

PVA west L and OP 8

No glare found

PVA west L and OP 10

No glare found

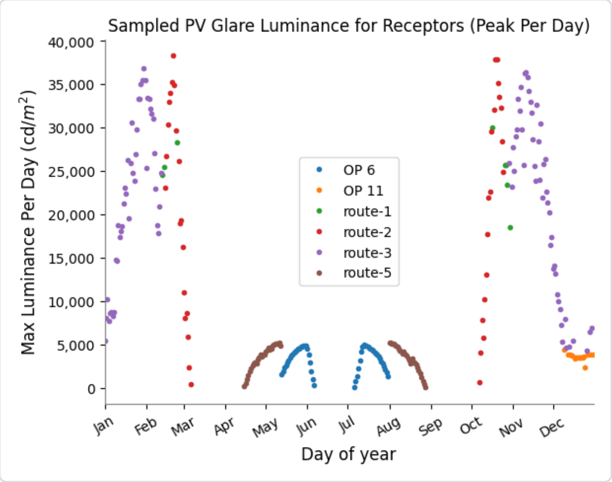
PVA west L and OP 11

No glare found

PV: PVB east H low potential for temporary after-image

Receptor results ordered by category of glare

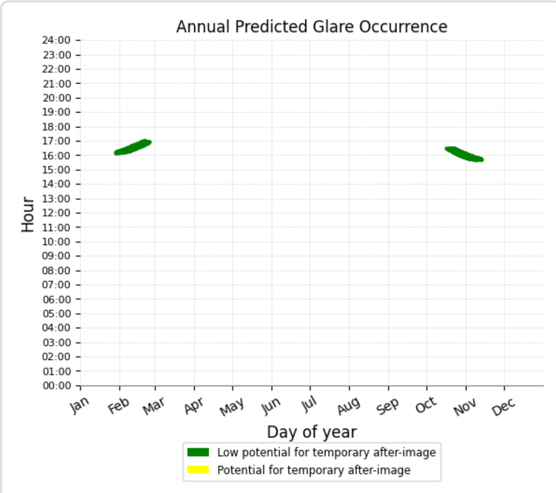
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
Route 1	760	12.7	0	0.0	30,020
Route 2	809	13.5	0	0.0	38,277
Route 3	1,341	22.4	0	0.0	36,812
Route 5	932	15.5	0	0.0	5,219
Route 4	0	0.0	0	0.0	0
FP 1	0	0.0	0	0.0	0
FP 2	0	0.0	0	0.0	0
OP 6	912	15.2	0	0.0	4,938
OP 7	510	8.5	0	0.0	4,221
OP 11	871	14.5	0	0.0	9,559
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0

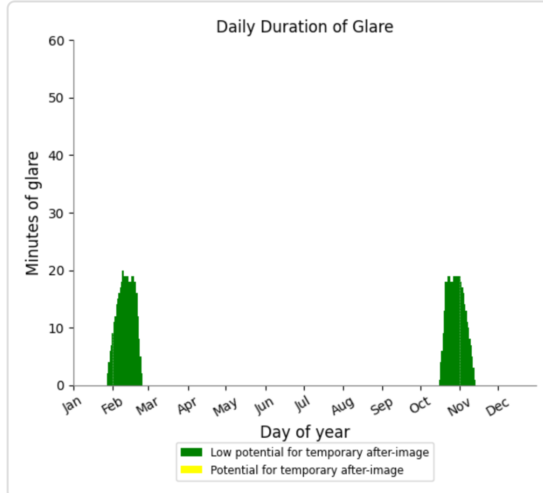


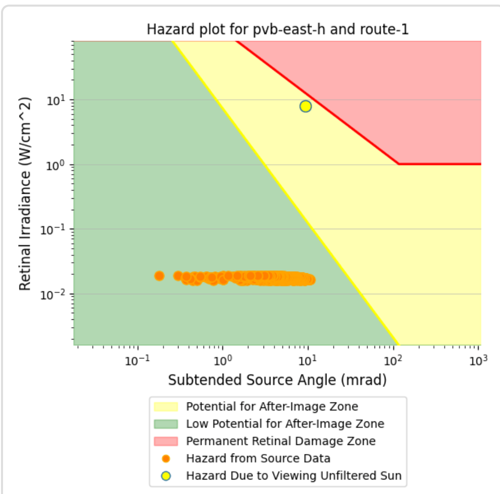
PVB east H and Route: Route 1

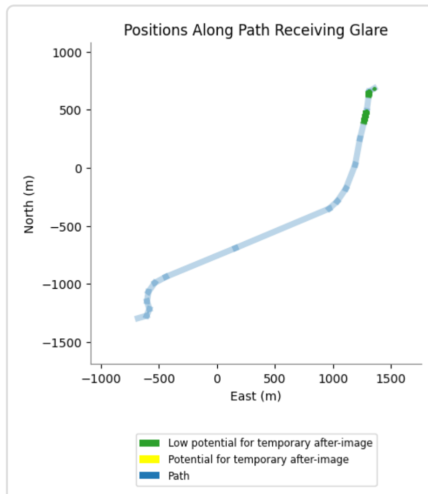
Yellow glare: none

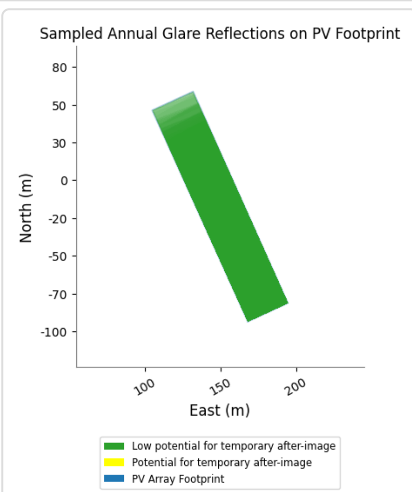
Green glare: 760 min.

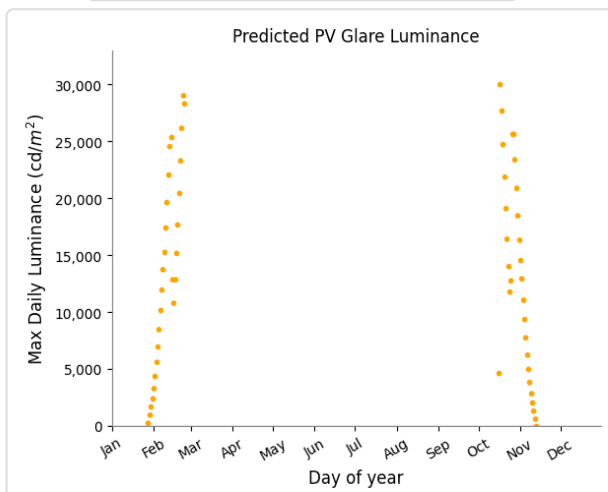








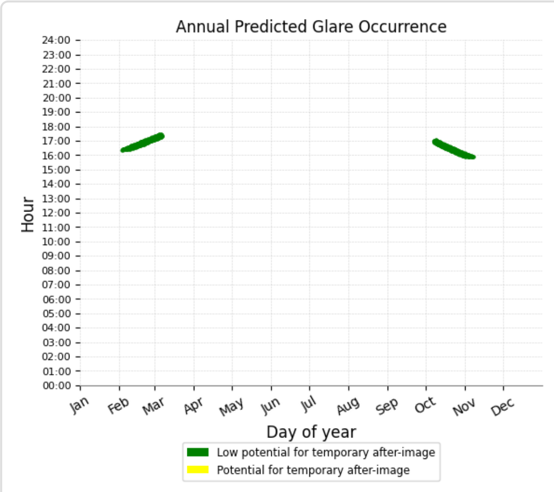


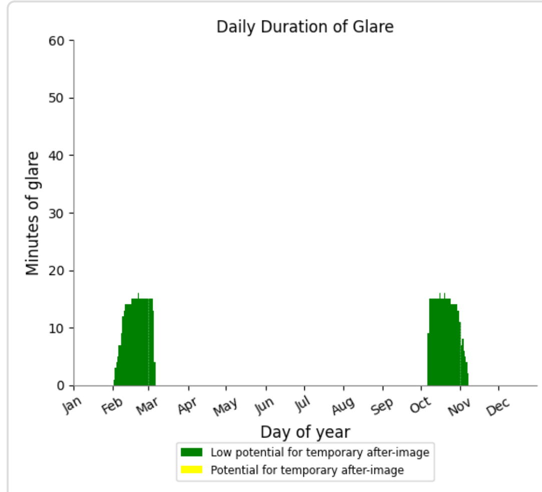


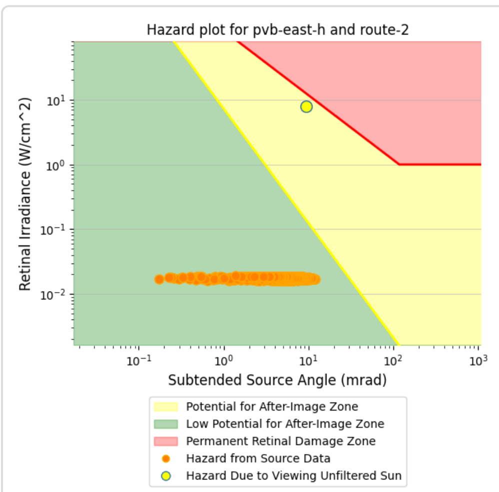
PVB east H and Route: Route 2

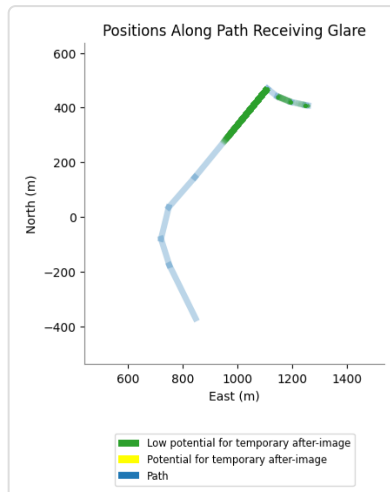
Yellow glare: none

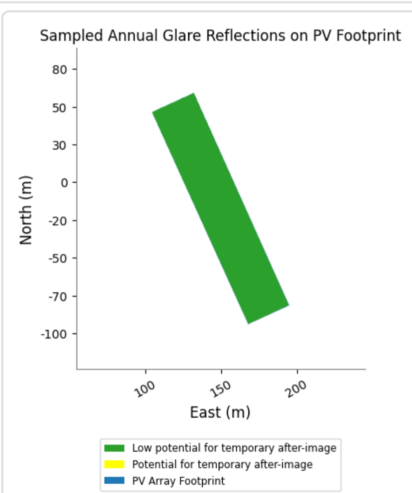
Green glare: 809 min.

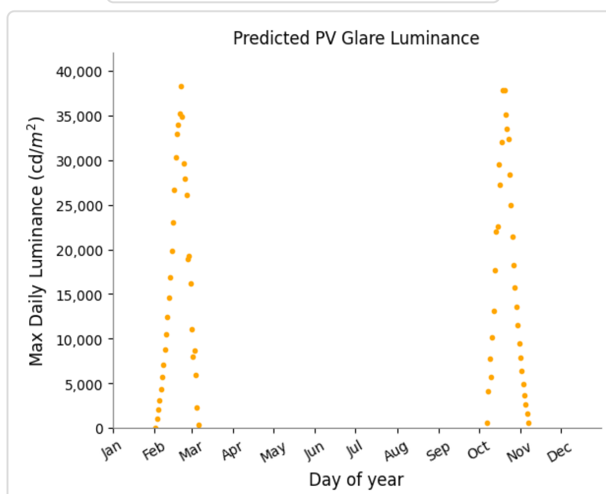








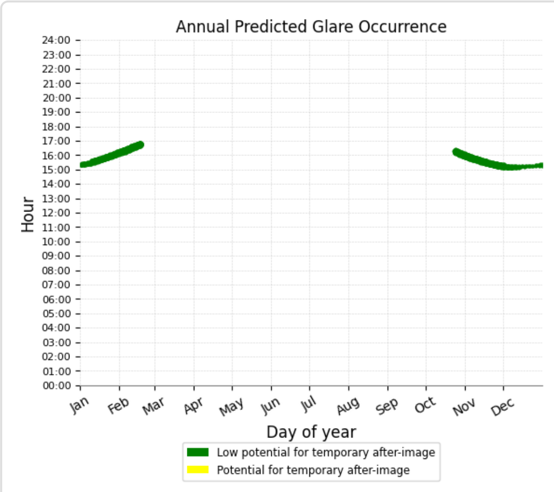


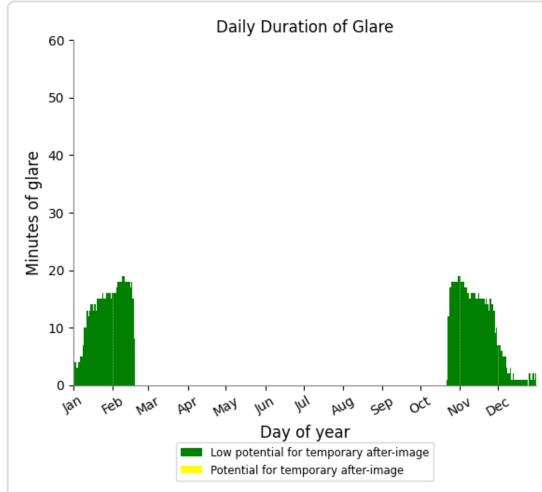


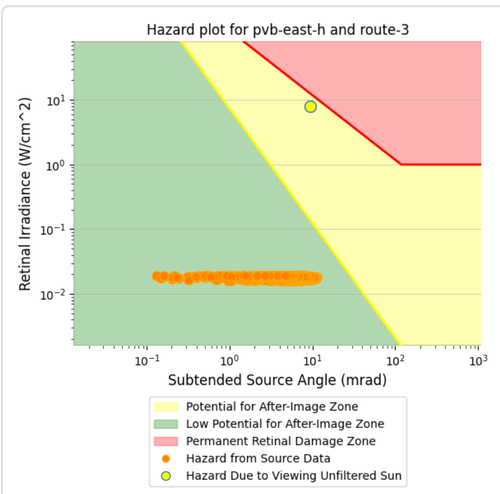
PVB east H and Route: Route 3

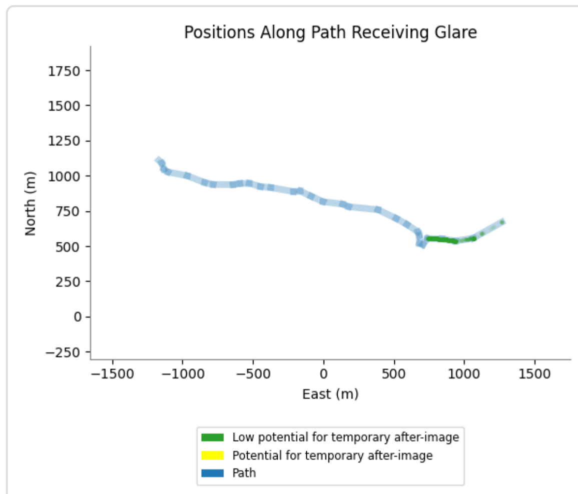
Yellow glare: none

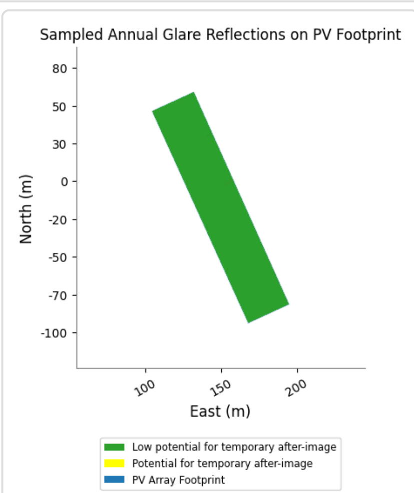
Green glare: 1,341 min.

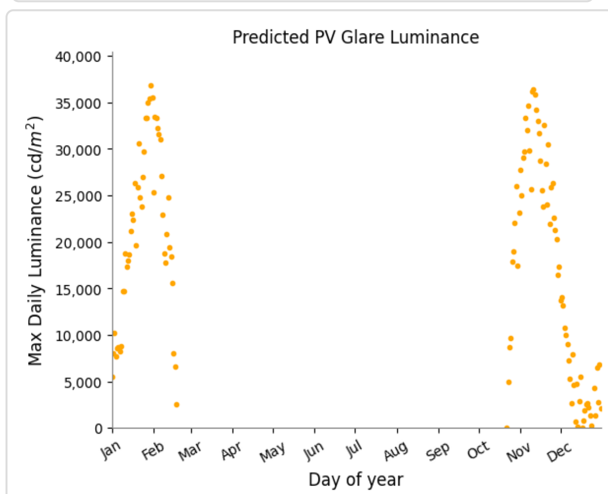








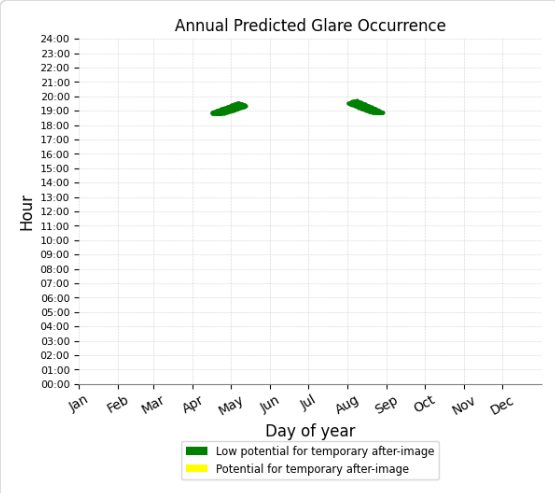


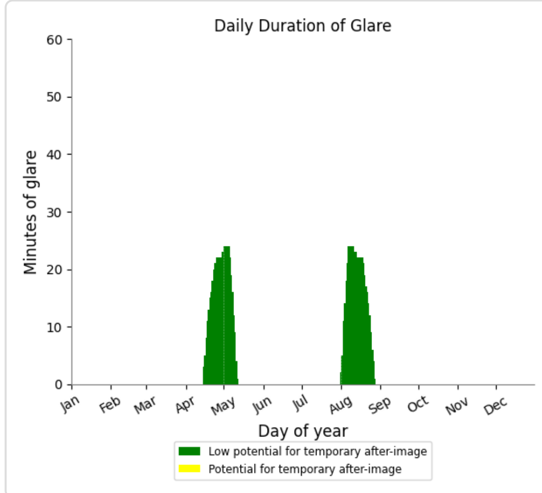


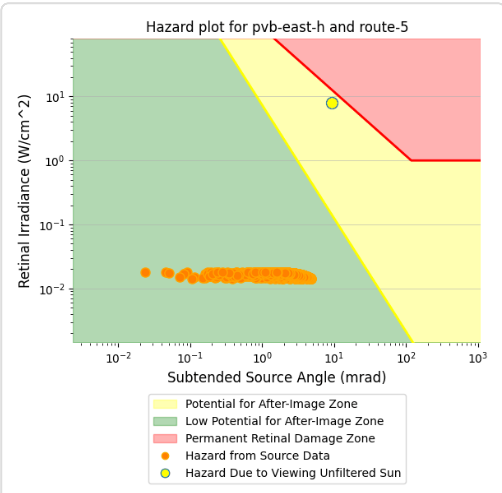
PVB east H and Route: Route 5

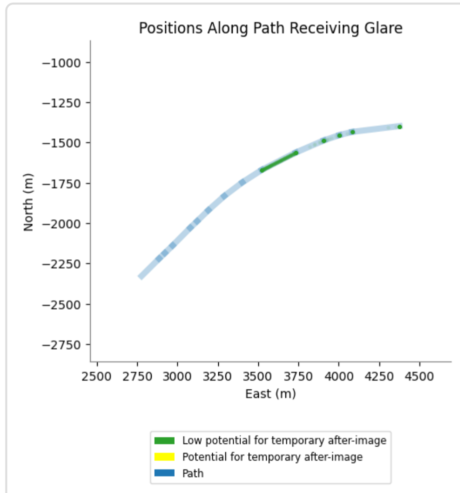
Yellow glare: none

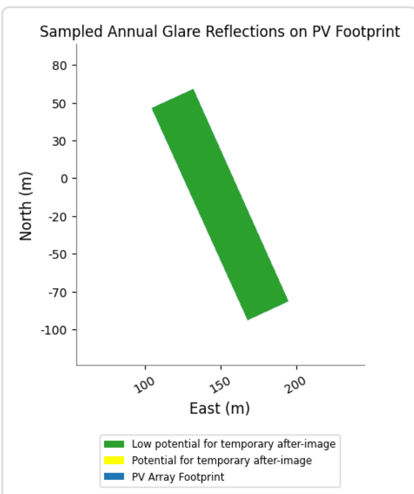
Green glare: 932 min.

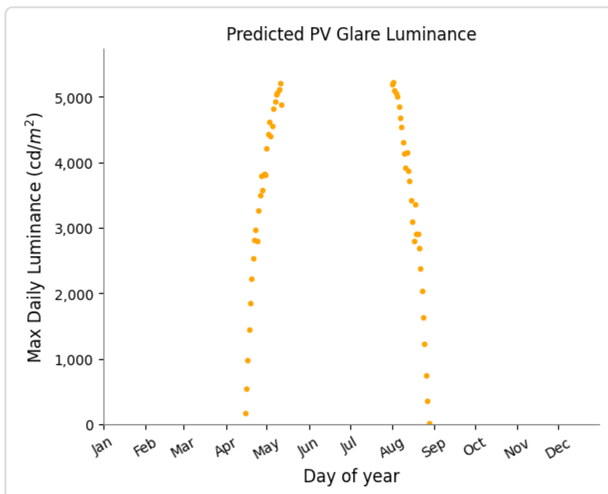












PVB east H and Route: Route 4

No glare found

PVB east H and FP: FP 1

No glare found

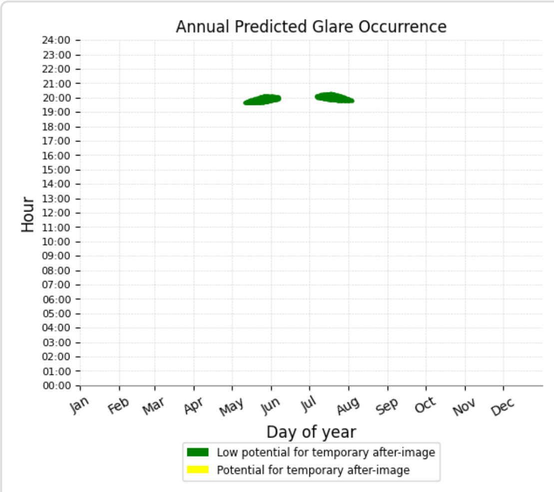
PVB east H and FP: FP 2

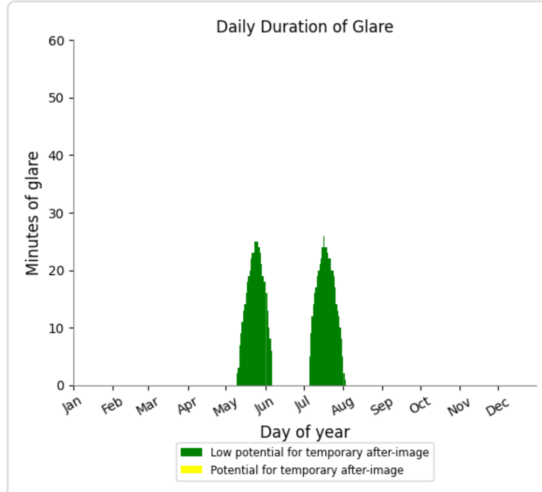
No glare found

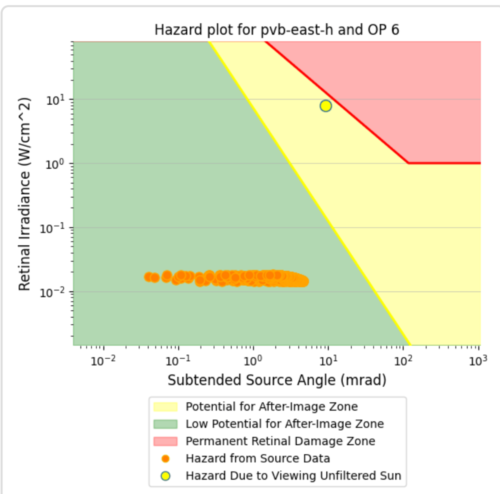
PVB east H and OP 6

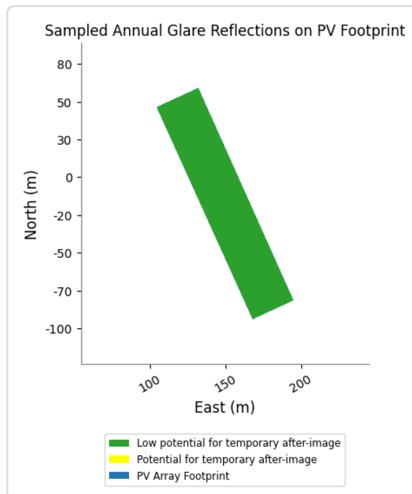
Yellow glare: none

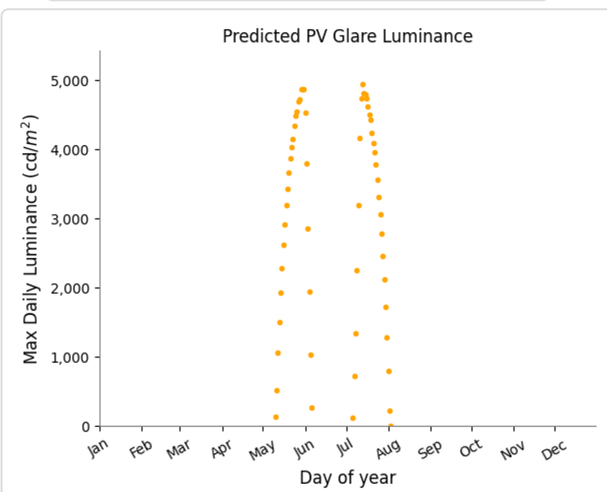
Green glare: 912 min.







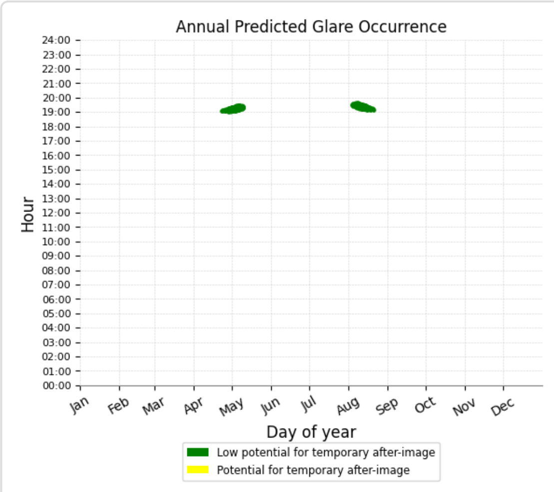


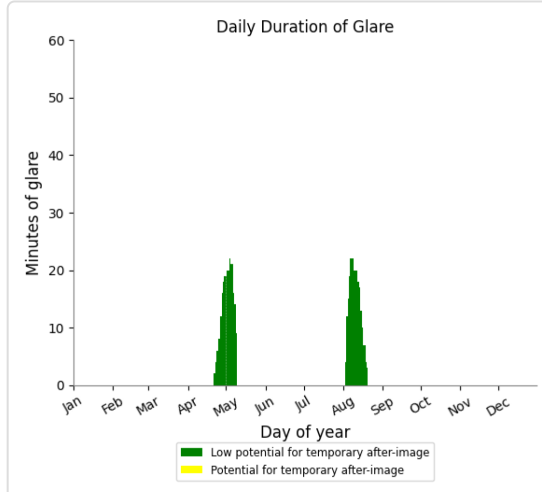


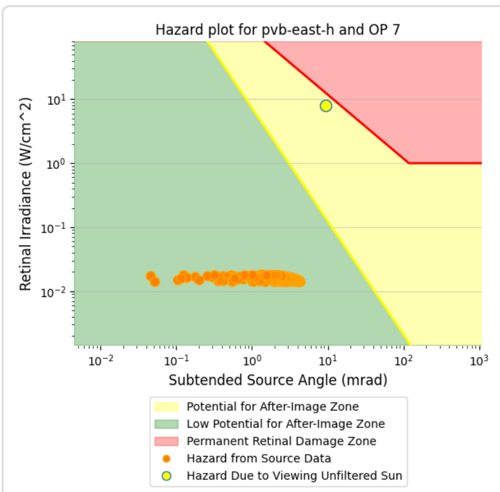
PVB east H and OP 7

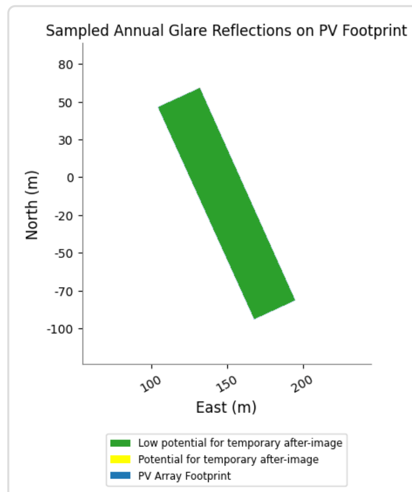
Yellow glare: none

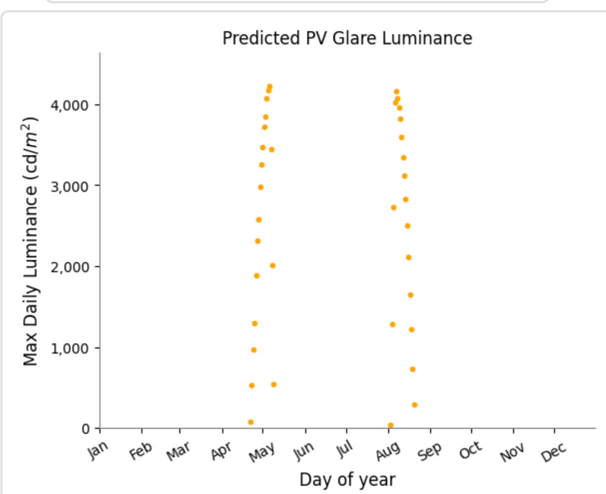
Green glare: 510 min.







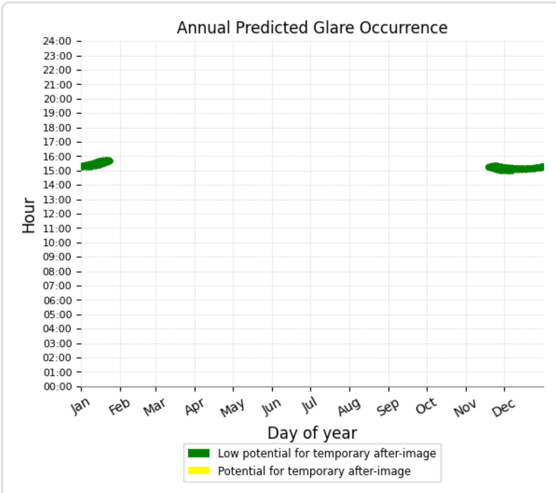


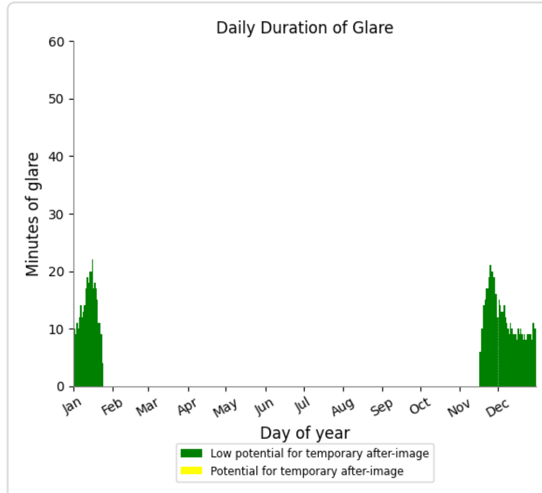


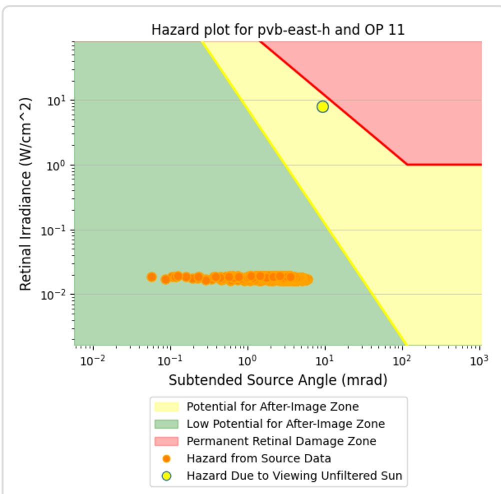
PVB east H and OP 11

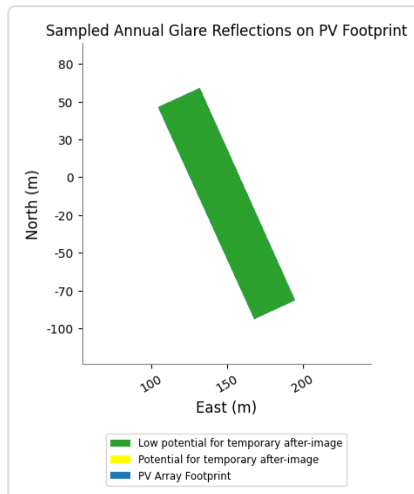
Yellow glare: none

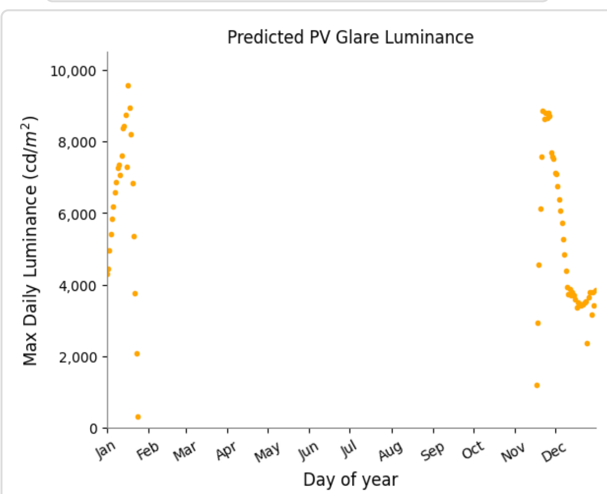
Green glare: 871 min.











PVB east H and OP 1

No glare found

PVB east H and OP 2

No glare found

PVB east H and OP 3

No glare found

PVB east H and OP 4

No glare found

PVB east H and OP 5

No glare found

PVB east H and OP 8

No glare found

PVB east H and OP 9

No glare found

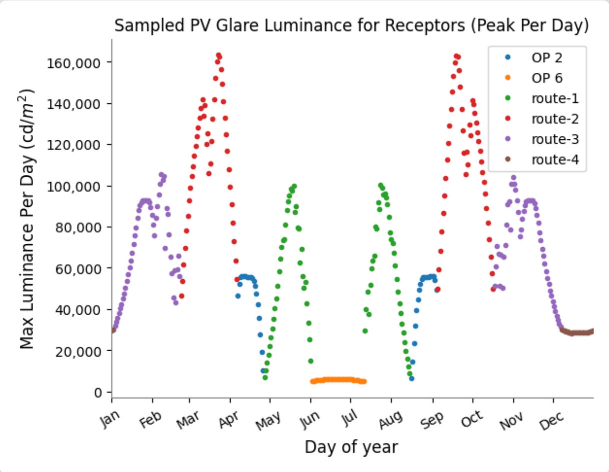
PVB east H and OP 10

No glare found

PV: PVB east L low potential for temporary after-image

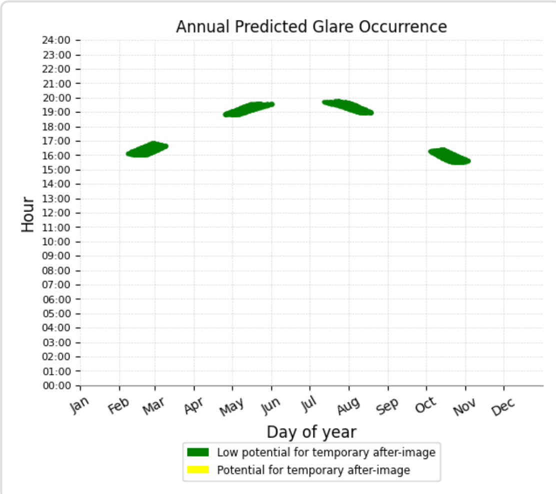
Receptor results ordered by category of glare

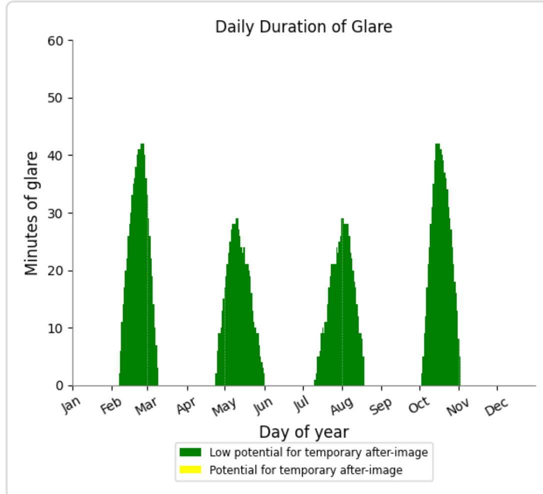
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
Route 1	2,922	48.7	0	0.0	100,205
Route 2	3,410	56.8	0	0.0	163,263
Route 3	5,018	83.6	0	0.0	105,443
Route 4	2,657	44.3	0	0.0	32,830
Route 5	2,009	33.5	0	0.0	7,531
FP 1	0	0.0	0	0.0	0
FP 2	0	0.0	0	0.0	0
OP 2	1,187	19.8	0	0.0	56,056
OP 4	1,432	23.9	0	0.0	54,156
OP 6	1,823	30.4	0	0.0	6,060
OP 7	1,228	20.5	0	0.0	6,156
OP 11	1,695	28.2	0	0.0	16,853
OP 1	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0

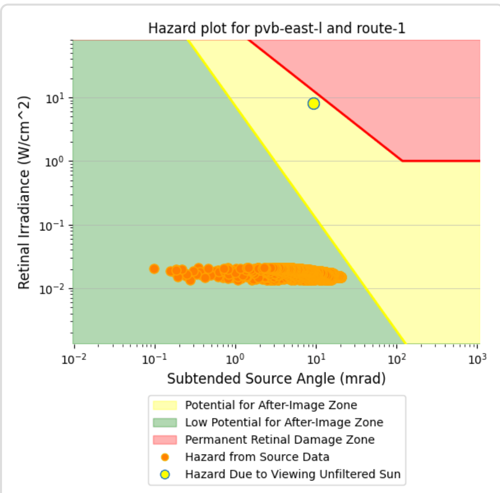


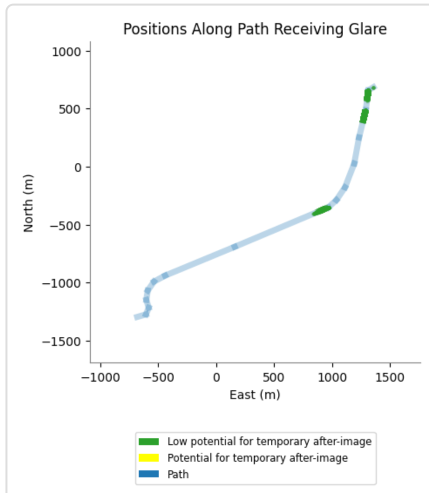
PVB east L and Route: Route 1

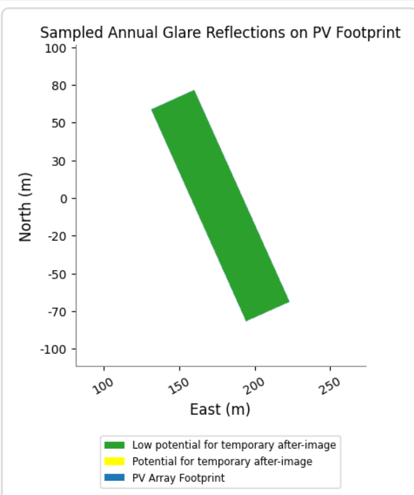
Yellow glare: none
Green glare: 2,922 min.

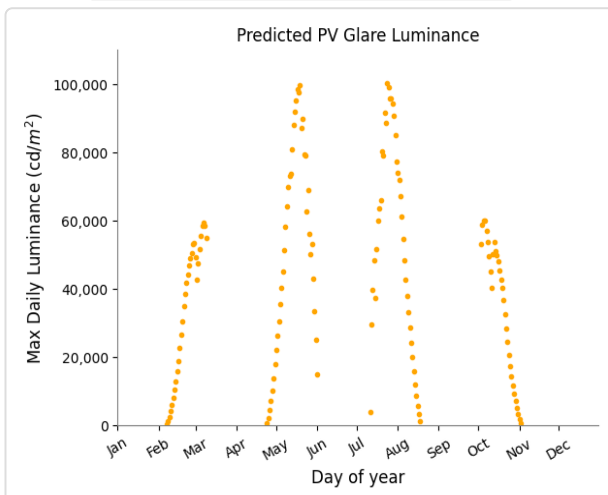








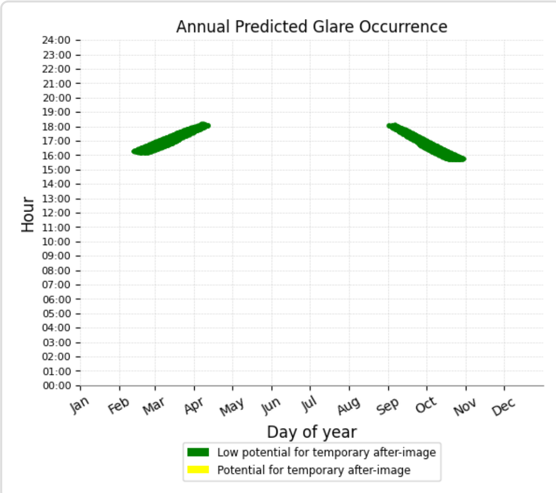


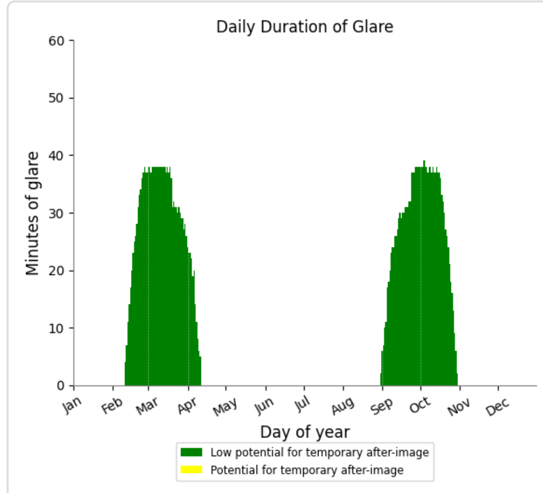


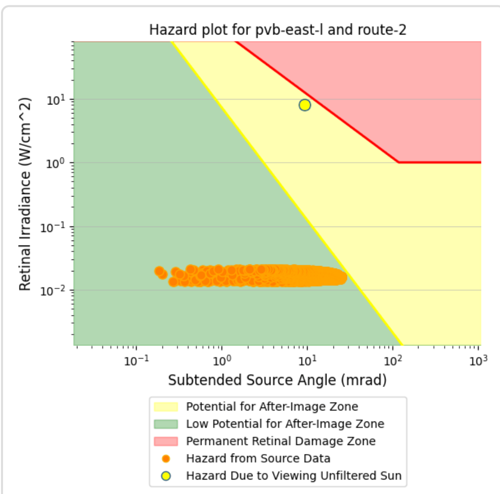
PVB east L and Route: Route 2

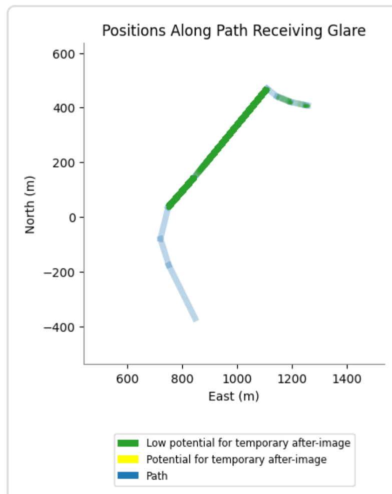
Yellow glare: none

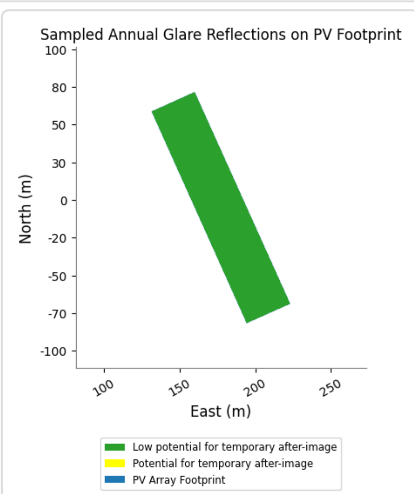
Green glare: 3,410 min.

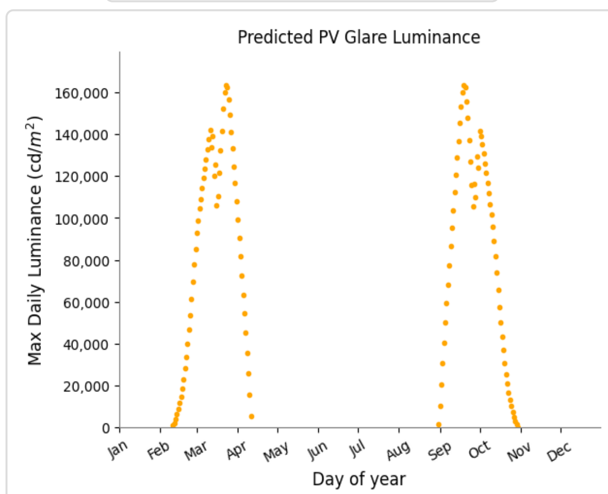










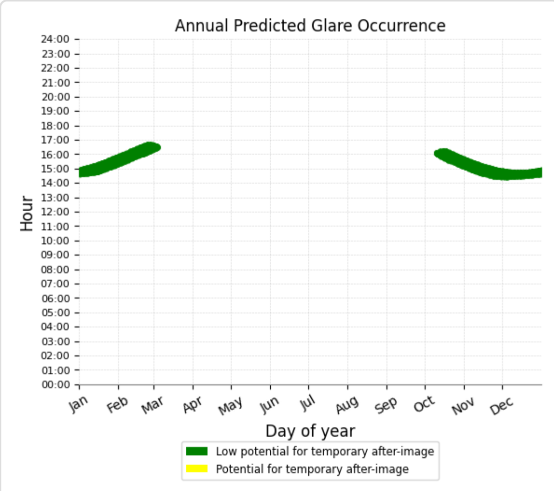


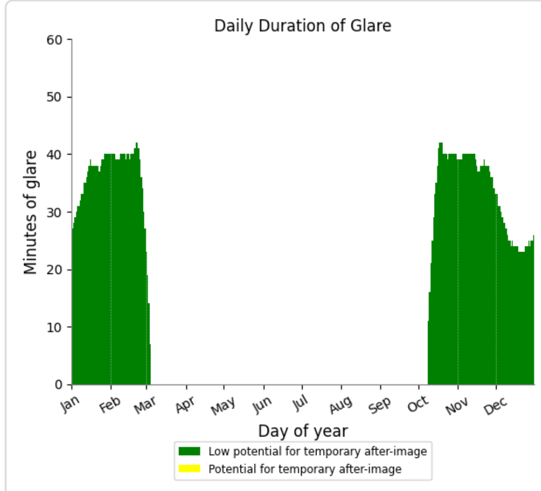
ForgeSolar

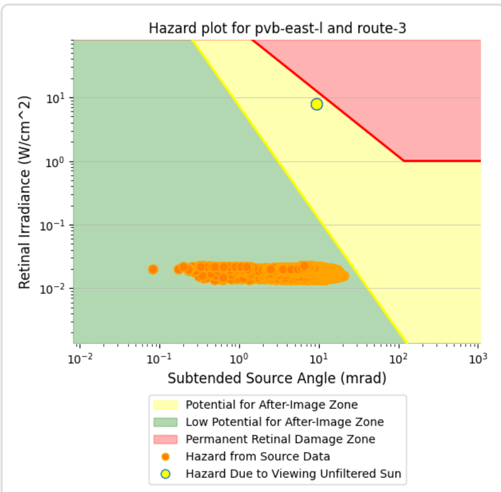
PVB east L and Route: Route 3

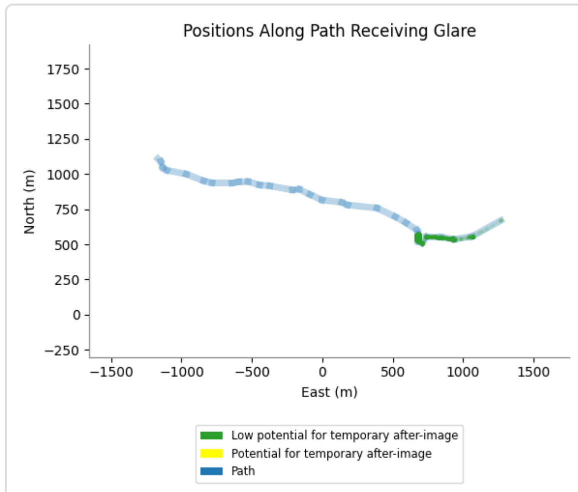
Yellow glare: none

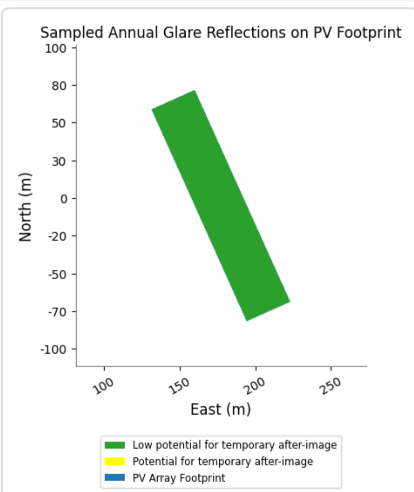
Green glare: 5,018 min.

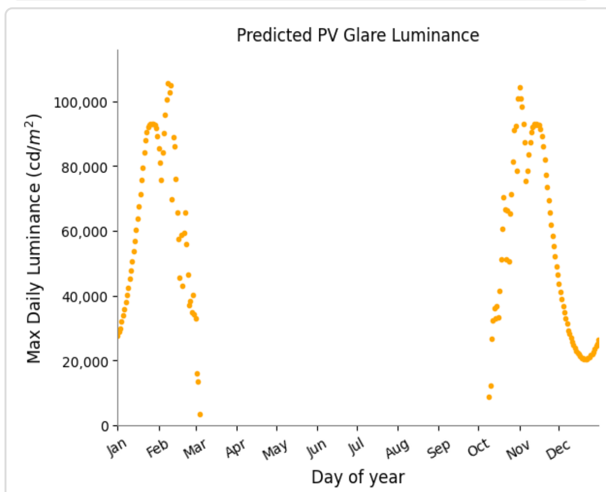








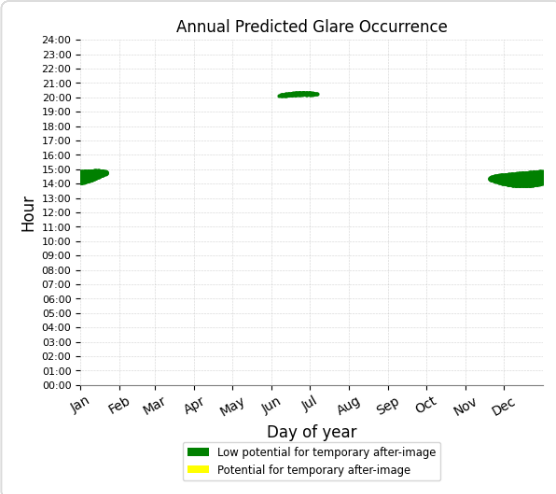


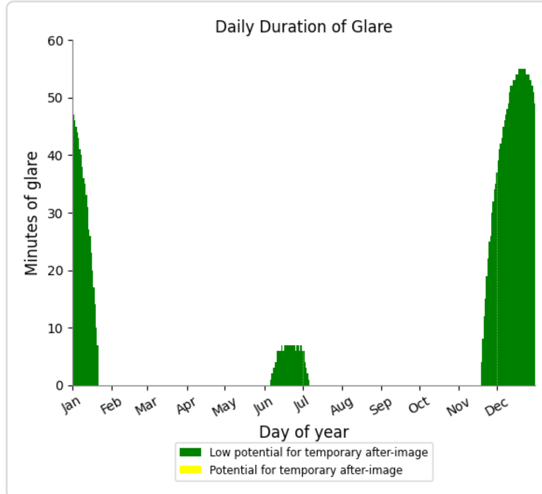


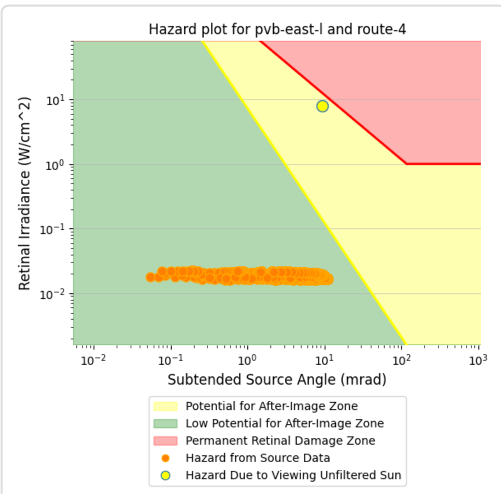
PVB east L and Route: Route 4

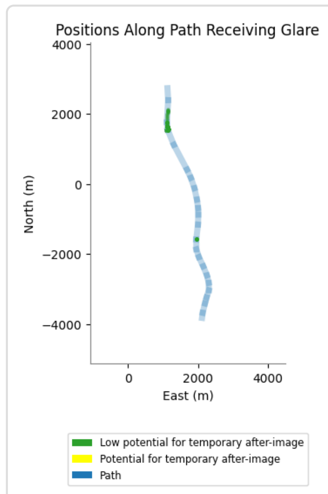
Yellow glare: none

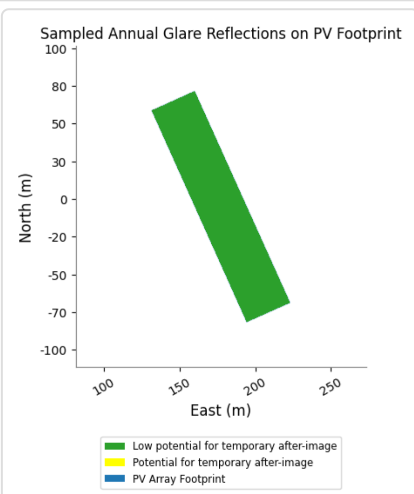
Green glare: 2,657 min.

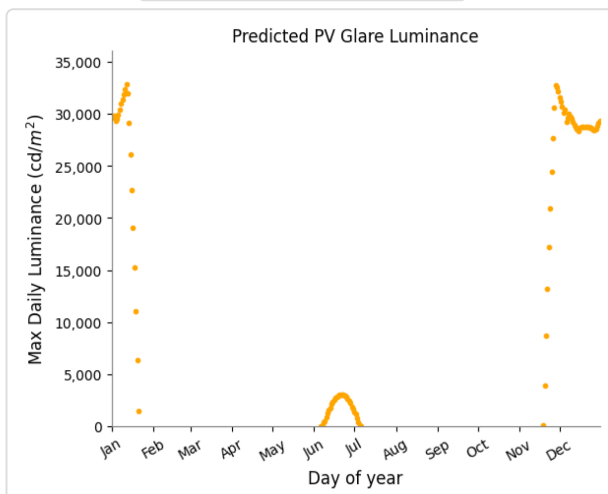








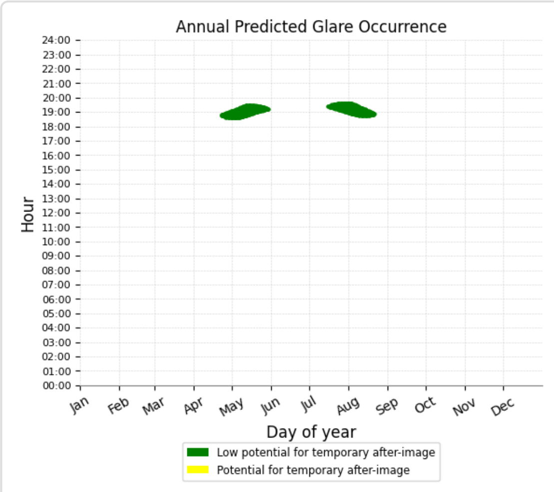


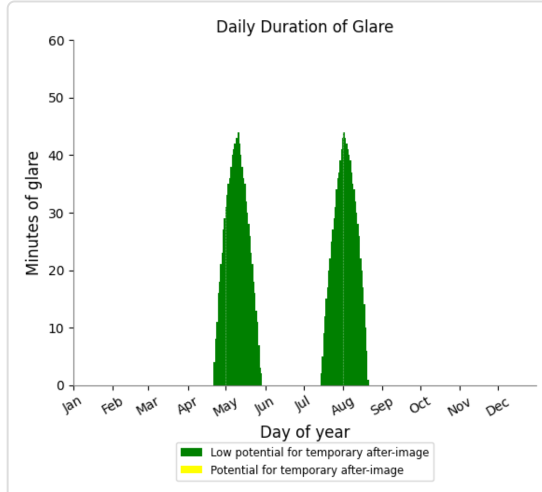


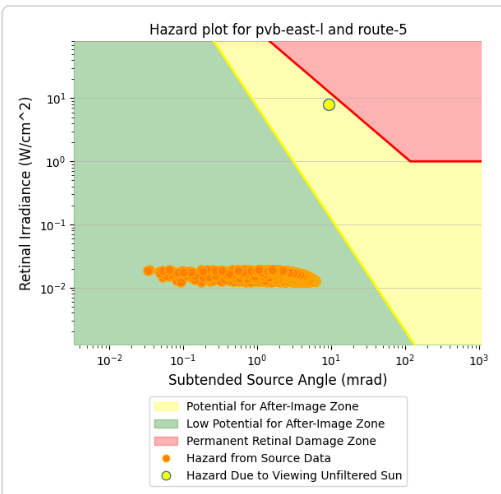
ForgeSolar

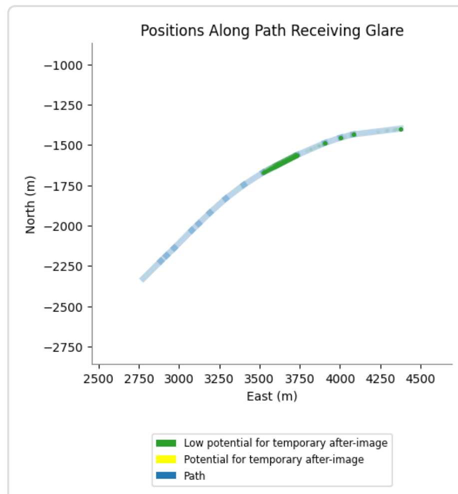
PVB east L and Route: Route 5

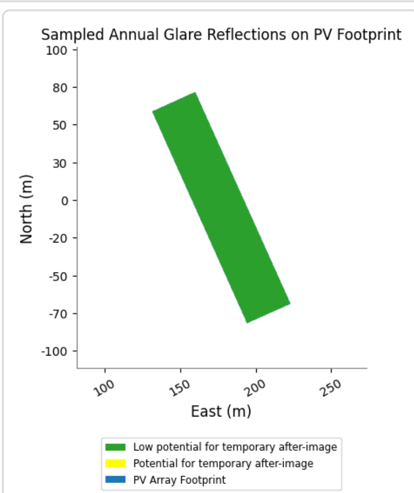
Yellow glare: none
Green glare: 2,009 min.

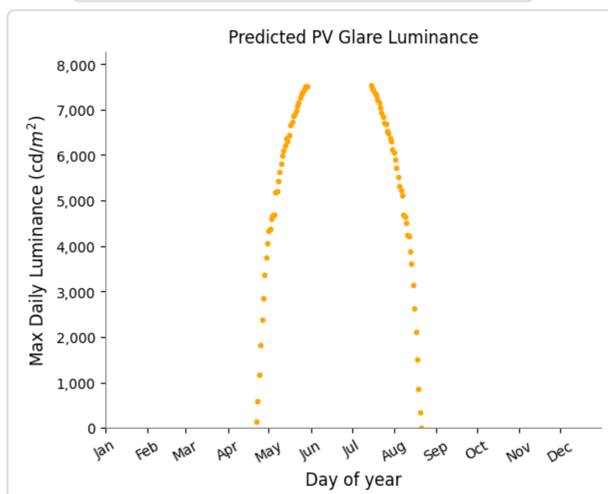












PVB east L and FP: FP 1

No glare found

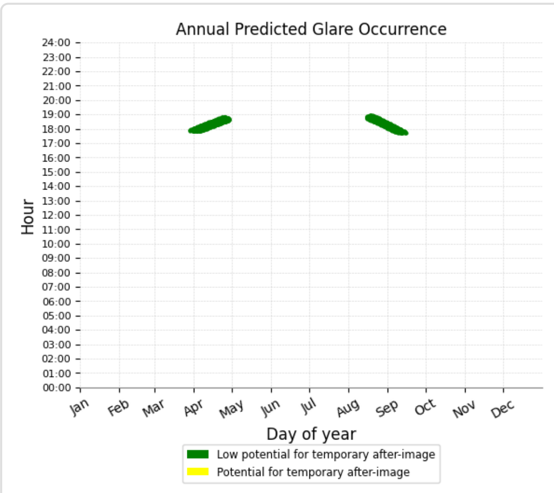
PVB east L and FP: FP 2

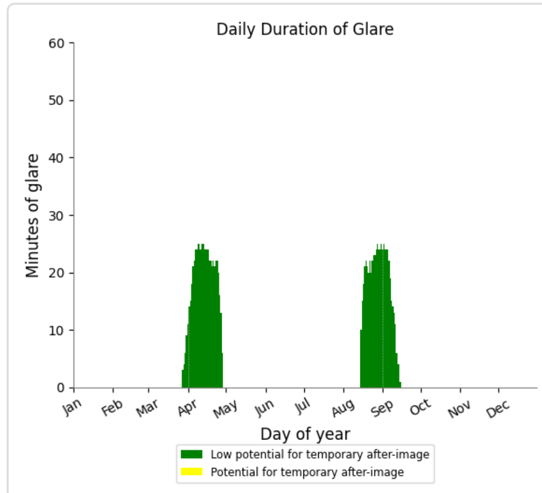
No glare found

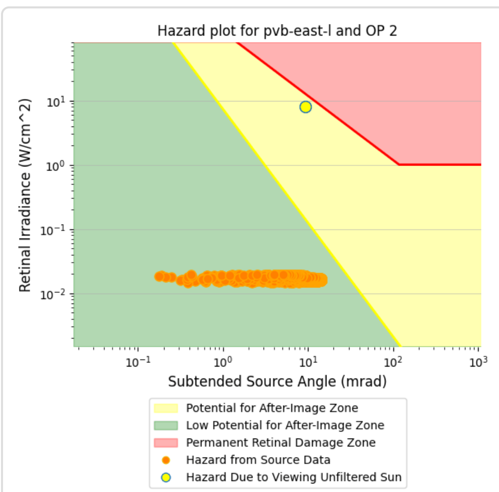
PVB east L and OP 2

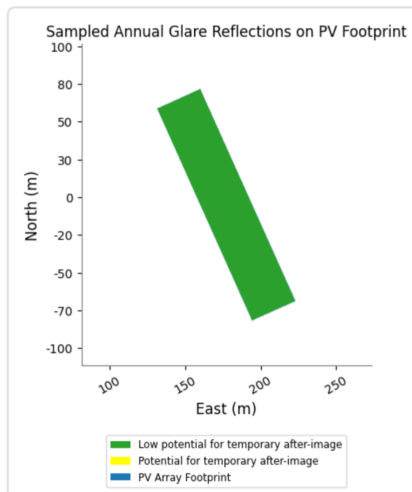
Yellow glare: none

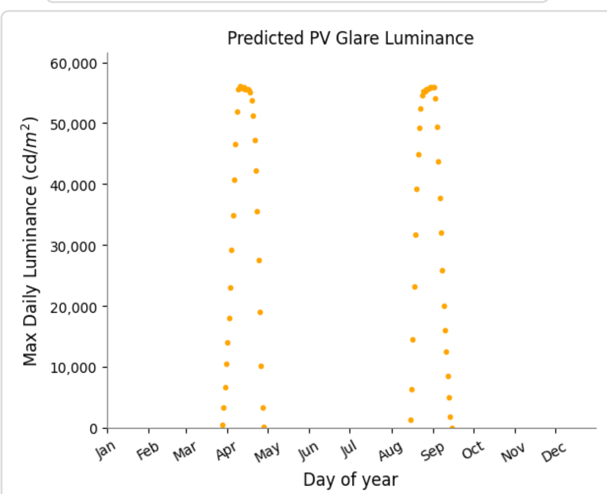
Green glare: 1,187 min.







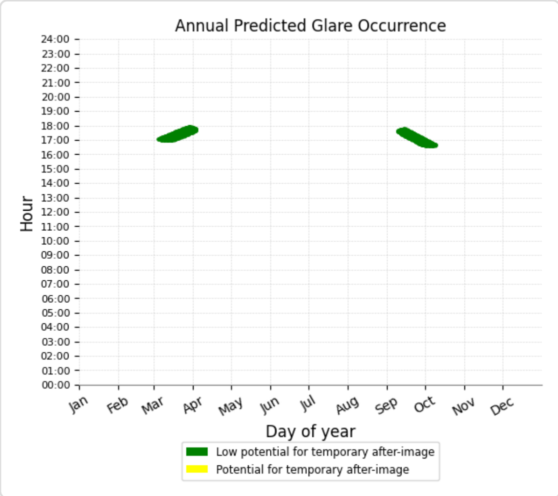


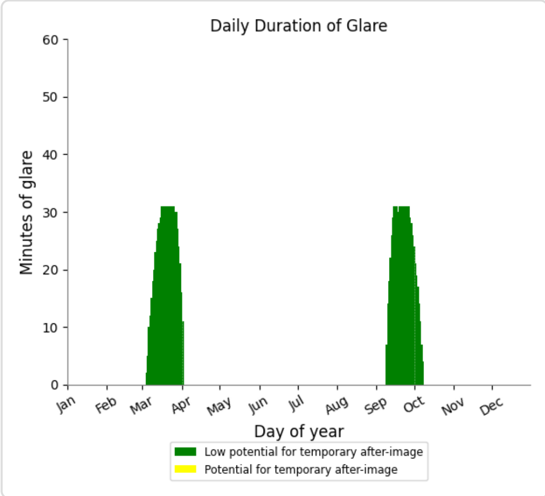


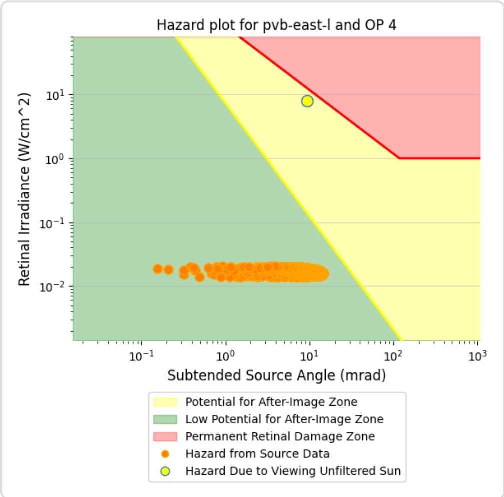
PVB east L and OP 4

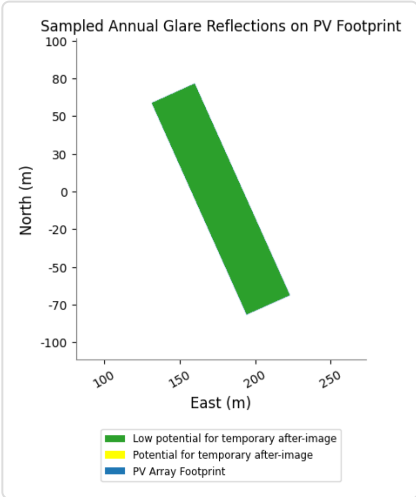
Yellow glare: none

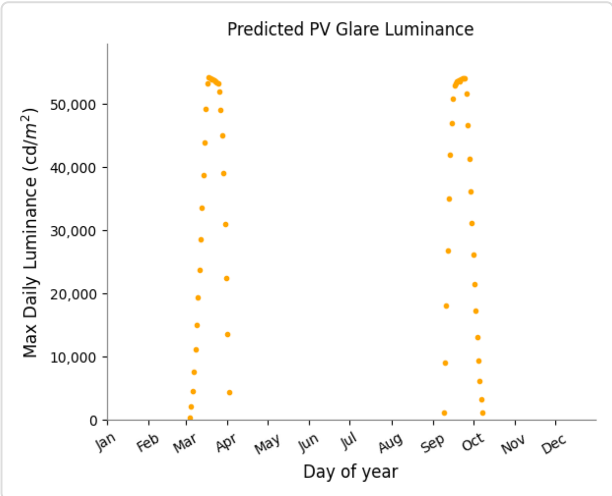
Green glare: 1,432 min.





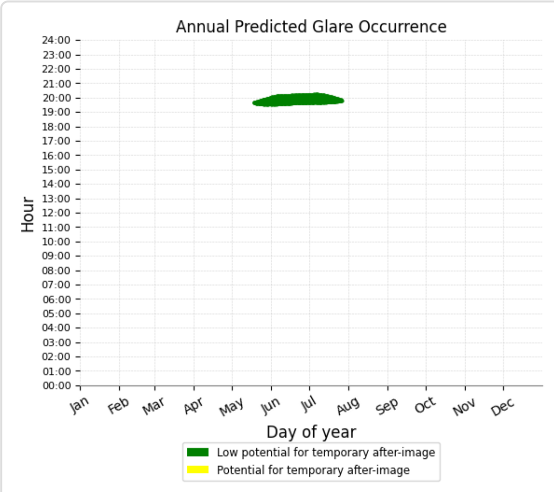


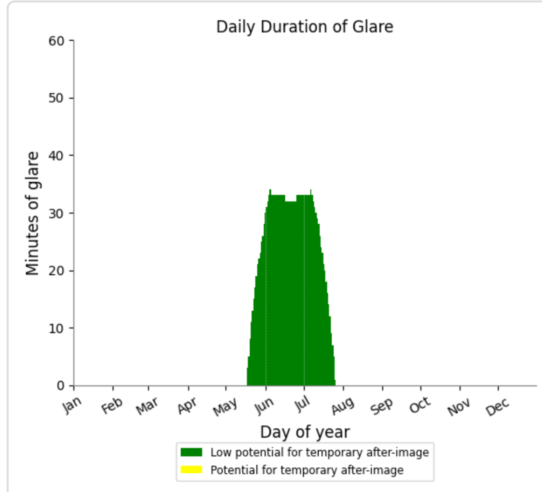


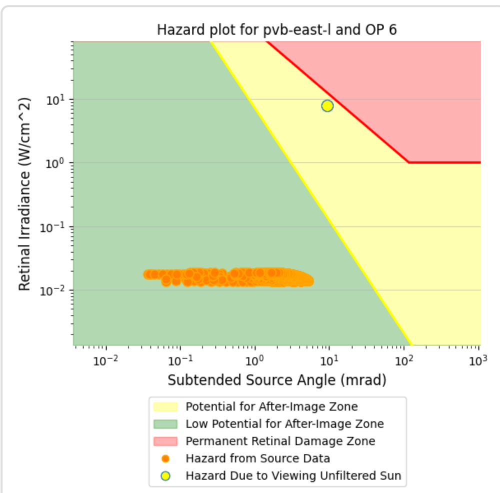


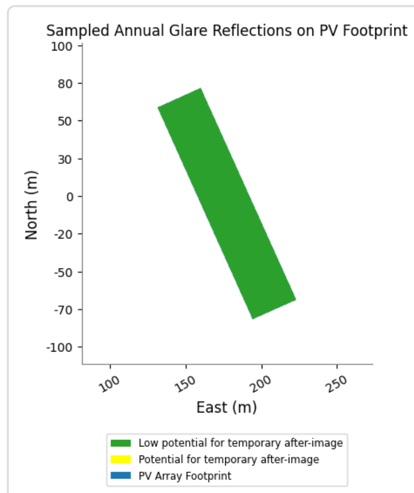
PVB east L and OP 6

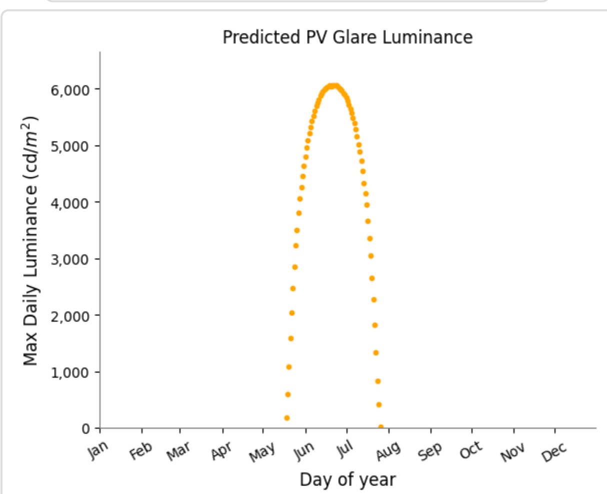
Yellow glare: none
Green glare: 1,823 min.







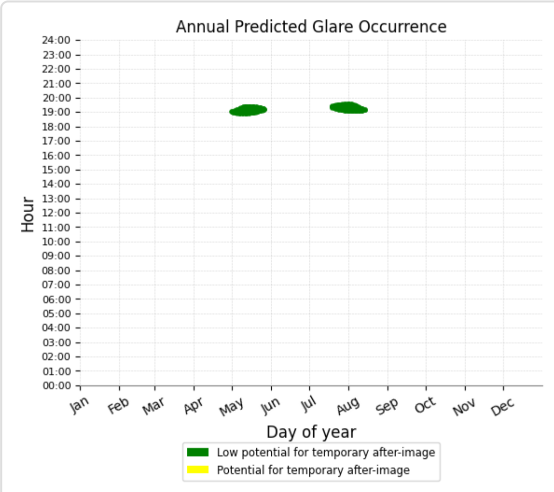


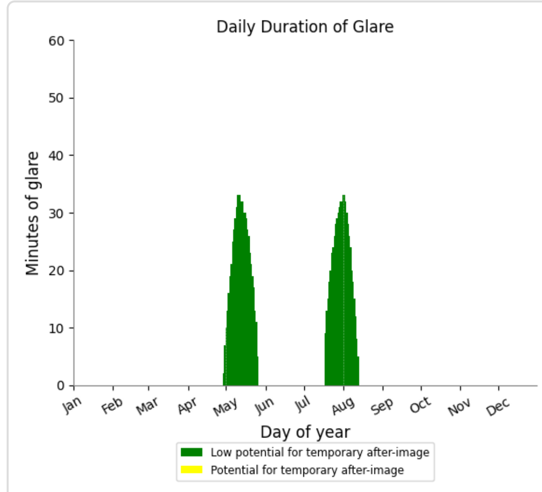


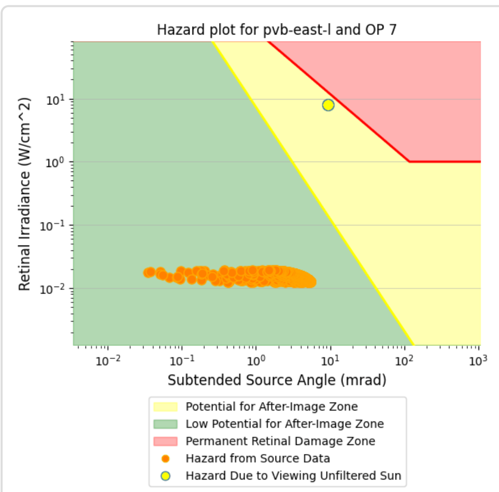
PVB east L and OP 7

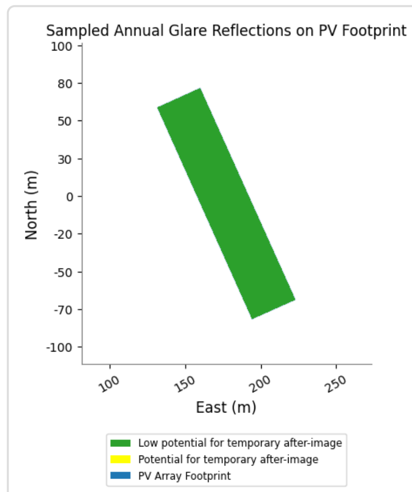
Yellow glare: none

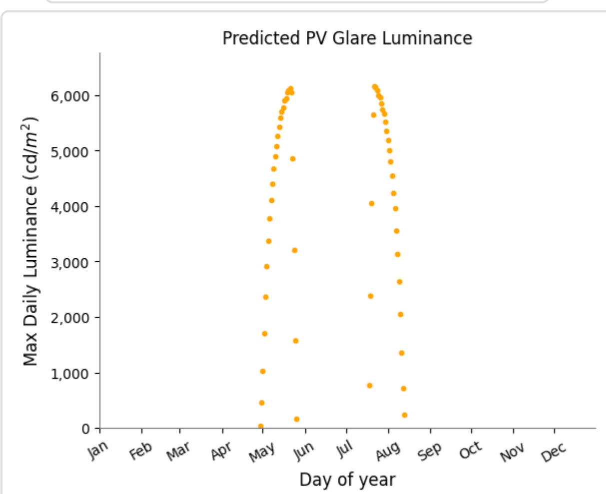
Green glare: 1,228 min.





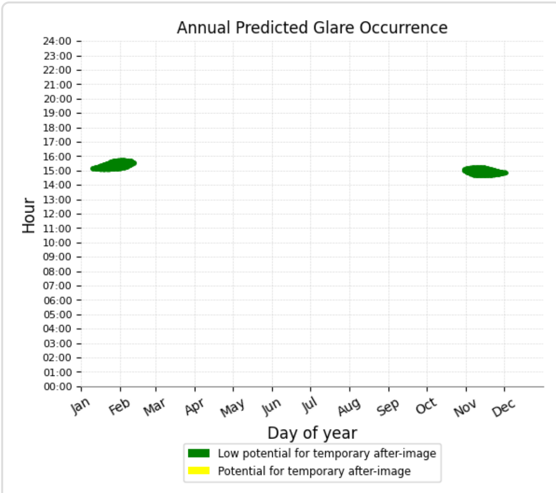


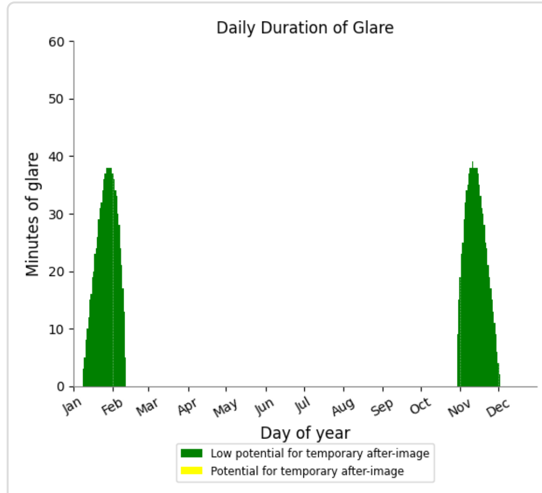


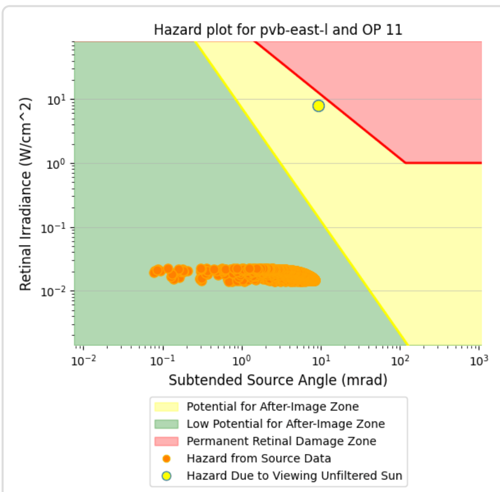


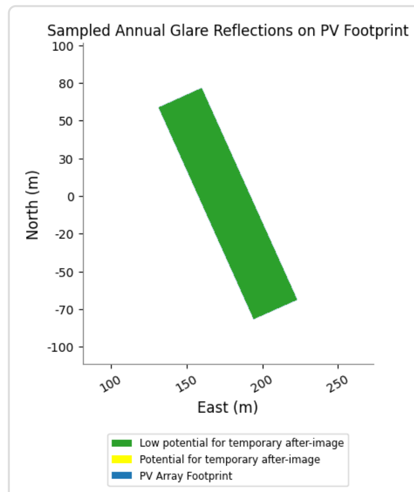
PVB east L and OP 11

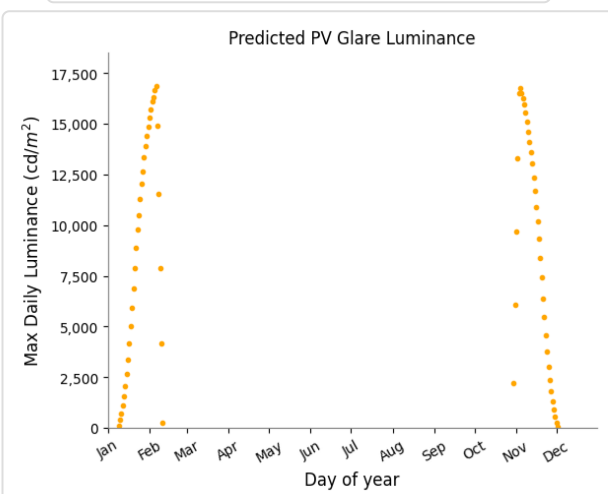
Yellow glare: none
Green glare: 1,695 min.











PVB east L and OP 1

No glare found

PVB east L and OP 3

No glare found

PVB east L and OP 5

No glare found

PVB east L and OP 8

No glare found

PVB east L and OP 9

No glare found

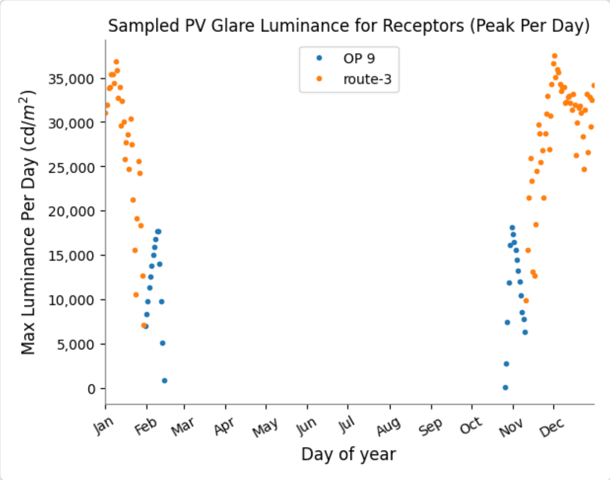
PVB east L and OP 10

No glare found

PV: PVB west H low potential for temporary after-image

Receptor results ordered by category of glare

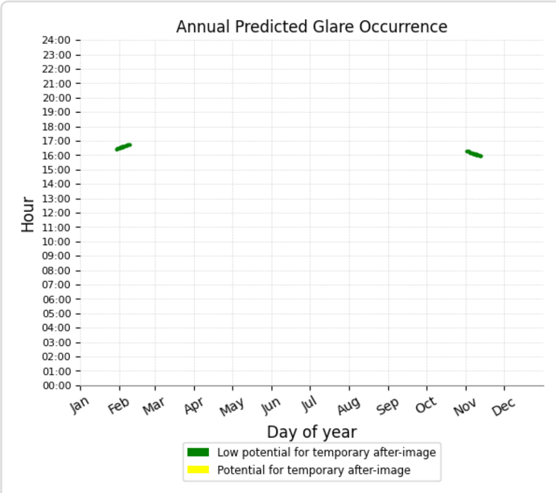
Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
Route 1	28	0.5	0	0.0	2,253
Route 3	1,757	29.3	0	0.0	37,473
Route 2	0	0.0	0	0.0	0
Route 4	0	0.0	0	0.0	0
Route 5	0	0.0	0	0.0	0
FP 1	0	0.0	0	0.0	0
FP 2	0	0.0	0	0.0	0
OP 9	508	8.5	0	0.0	18,141
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0

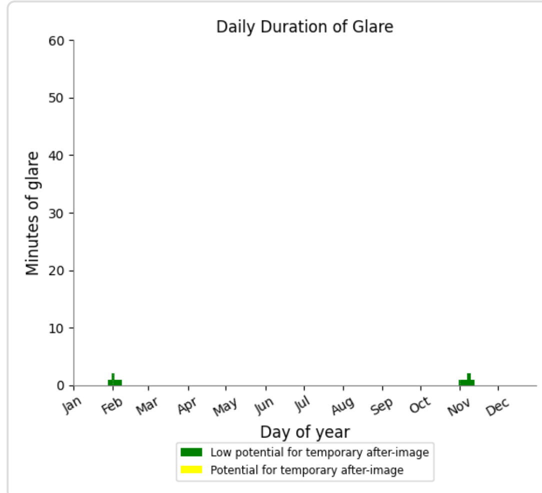


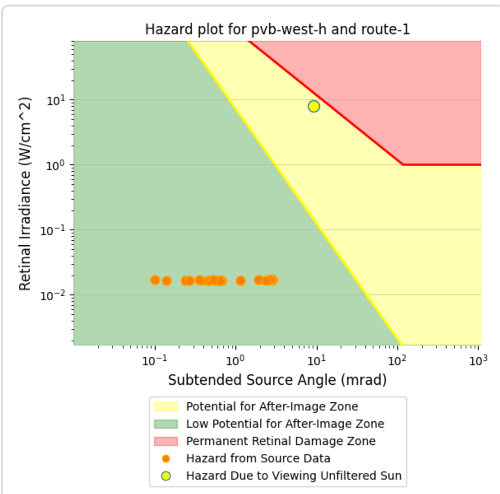
PVB west H and Route: Route 1

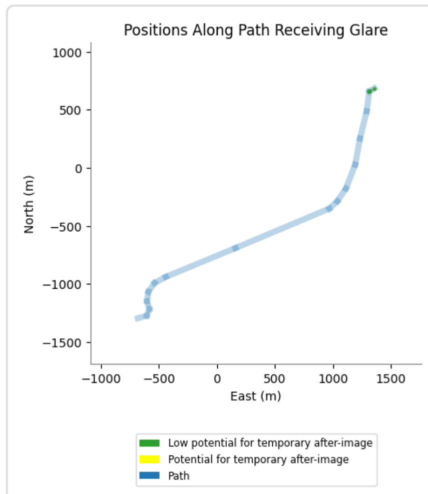
Yellow glare: none

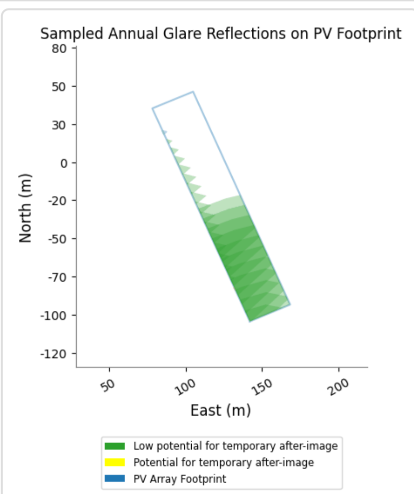
Green glare: 28 min.

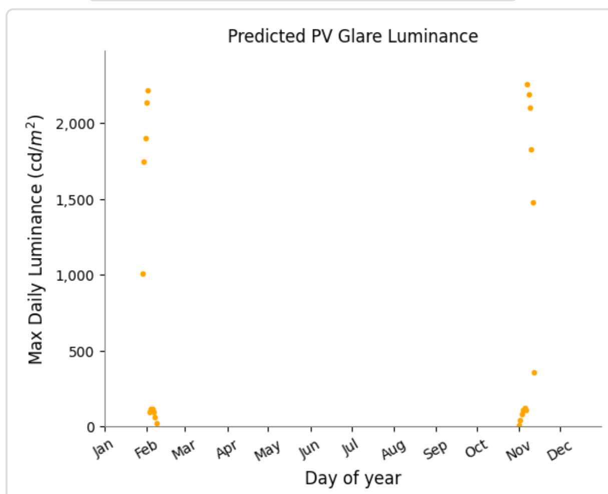






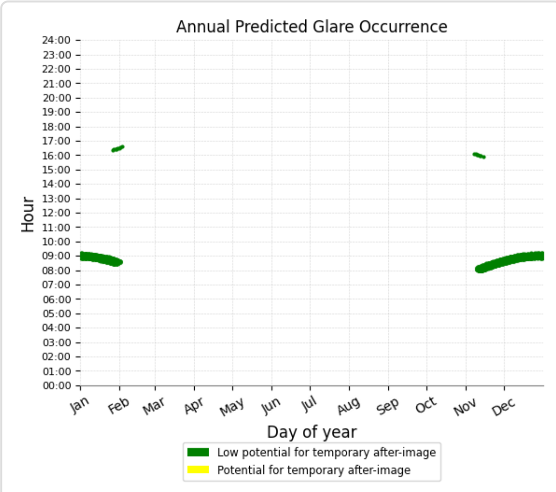


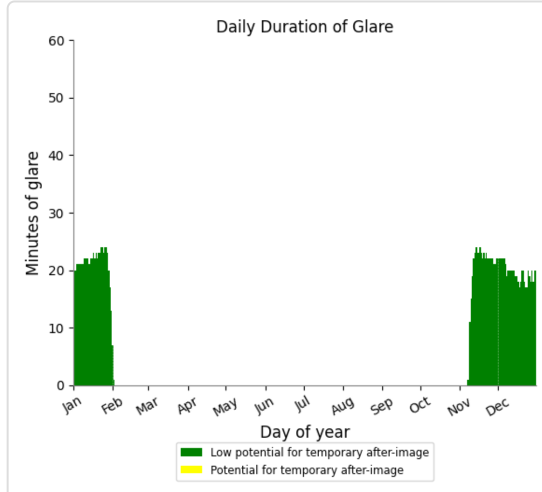


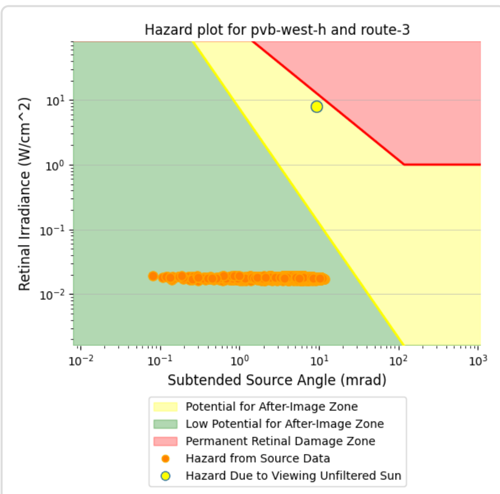


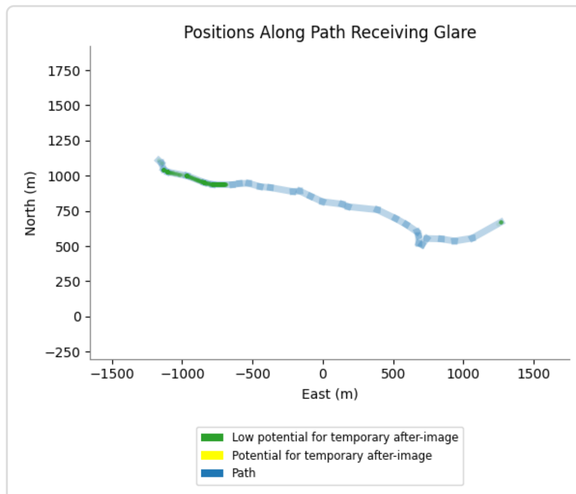
PVB west H and Route: Route 3

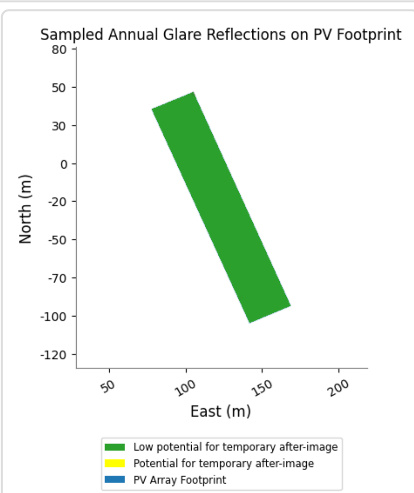
Yellow glare: none
Green glare: 1,757 min.

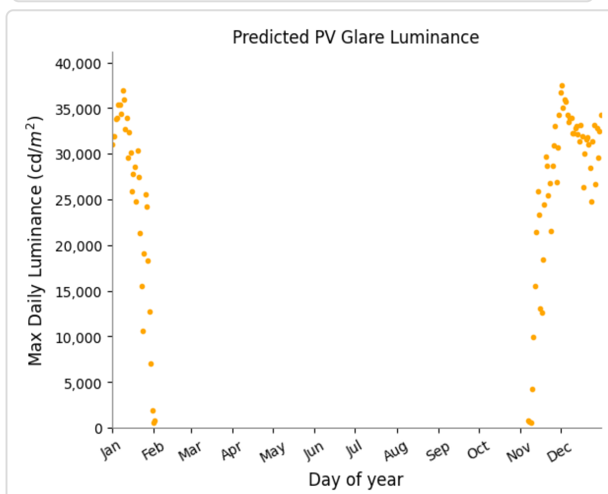












PVB west H and Route: Route 2

No glare found

PVB west H and Route: Route 4

No glare found

PVB west H and Route: Route 5

No glare found

PVB west H and FP: FP 1

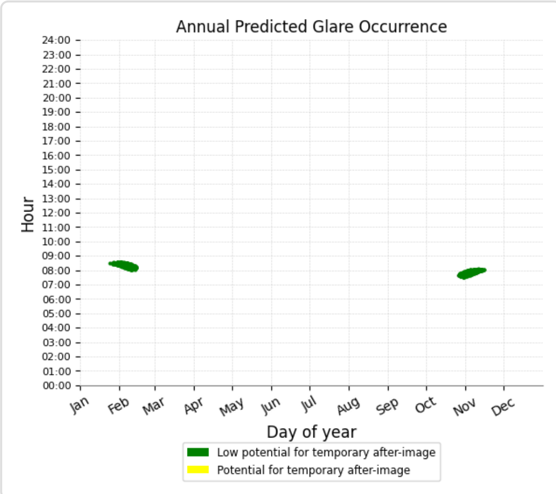
No glare found

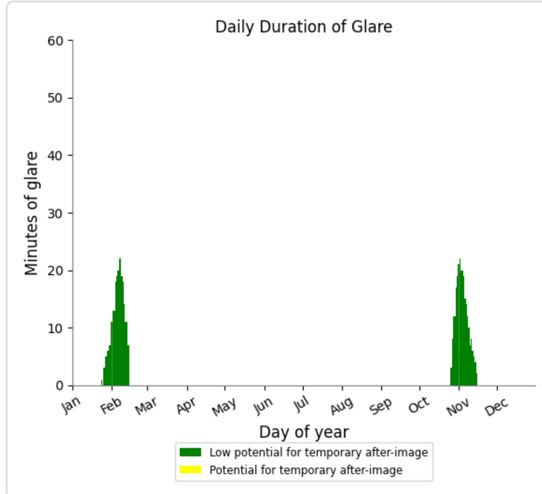
PVB west H and FP: FP 2

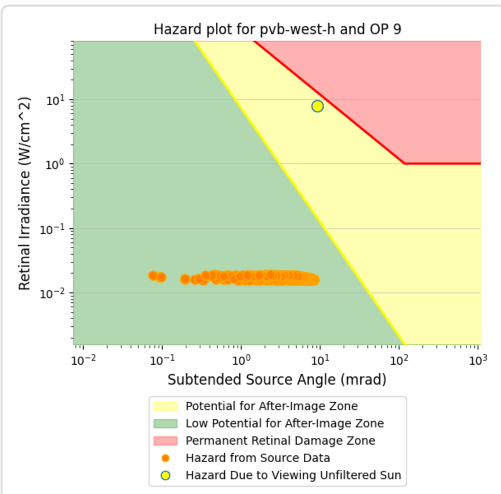
No glare found

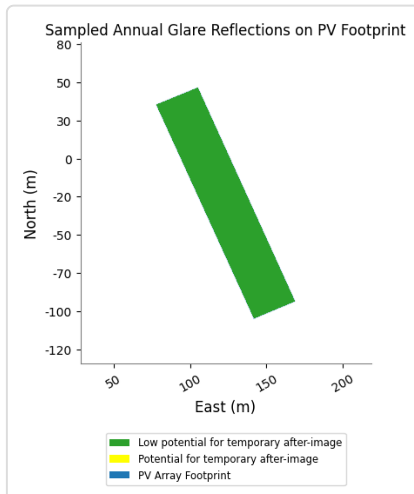
PVB west H and OP 9

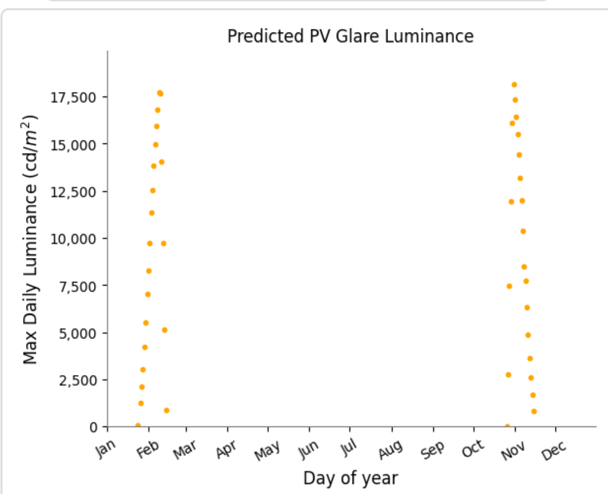
Yellow glare: none
Green glare: 508 min.











PVB west H and OP 1

No glare found

PVB west H and OP 2

No glare found

PVB west H and OP 3

No glare found

PVB west H and OP 4

No glare found

PVB west H and OP 5

No glare found

PVB west H and OP 6

No glare found

PVB west H and OP 7

No glare found

PVB west H and OP 8

No glare found

PVB west H and OP 10

No glare found

PVB west H and OP 11

No glare found

PV: PVB west L low potential for temporary after-image

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
Route 3	2,210	36.8	0	0.0	61,880
Route 1	0	0.0	0	0.0	0
Route 2	0	0.0	0	0.0	0
Route 4	0	0.0	0	0.0	0
Route 5	0	0.0	0	0.0	0
FP 1	0	0.0	0	0.0	0
FP 2	0	0.0	0	0.0	0
OP 9	854	14.2	0	0.0	28,209
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0